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ABSTRACT

A science and engineering fair is a competition based on the quality of projects done by students, the results of which are reported through exhibits and oral presentations at the fair. Fairs operate on a step basis. Students who win in small, local fairs, move to a city fair, then to a regional fair, and may be chosen to represent that fair in the International Science and Engineering Fair (ISEF). The finalists whose project abstracts are reported in this book won the honor of presenting their projects at the 39th ISEF in Knoxville, Tennessee, in May 1988 as the result of being chosen the best in 381 affiliated fairs. Abstracts are organized by project categories. These 13 groups are described and include: behavioral and social sciences; biochemistry; botany; chemistry; computer science; earth and space sciences; engineering; environmental sciences; mathematics; medicine and health; microbiology; physics; and zoology. An index is also included of all the finalists. (CW)

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ABSTRACTS

39th International Science and Engineering Fair

Abstracts of the Finalists

of the

International Science and Engineering Fair

held in

Knoxville, Tennessee

May 8-14, 1988

SCIENCE SERVICE
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PREFACE

A science and engineering fair is a competition based on the quality of projects done by students, the results of which are reported through exhibits and oral presentations at the fair.

The purpose of fairs is threefold: to stimulate in young people an active interest in science and engineering; to provide an educational experience through being exposed to the judges and to the public; and to give public recognition to talented students for the work they have done.

Fairs range in scope from the local level, which may involve one class, or one district, to ones which may involve a large city, a county, a state, or even a nation. While there are no exact figures, it is estimated that more than one and one half million student projects are undertaken each year in the United States, and that there are fairs in more than twenty other different countries.

Science and engineering fairs operate on a step basis, with students who have won in small fairs participating in large fairs as representatives of the fairs in which they have previously won. Thus, an individual might participate in a local fair, move to a city fair, then to a regional fair, and be chosen there to represent that fair in the International Science and Engineering Fair.

The finalists whose project abstracts are reported in this book won the honor of presenting their projects at the 39th ISEF in Knoxville, Tennessee, in May 1988 as the result of being chosen the best in 381 affiliated fairs.

Science Service, the nonprofit institution devoted to the public understanding of science, which conducts the International Science and Engineering Fair, pays tribute to these finalists, to their teachers, and to the thousands of individuals and organizations who made possible the presence of these ISEF finalists in Knoxville.

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BEHAVIORAL AND SOCIAL SCIENCES

IS THIS A HALF DUGOUT OR A NATURAL DEPRESSION? AN ARCHEOLOGICAL EXCAVATION

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The purpose of my project is to determine if a depression found in the middle of a homestead was a half-dugout or just a natural depression. The depression was believed to be the remains of a dugout. This hypothesis could be supported by finding evidence of the ground being disturbed.

In 1986, the site was selected and three sample rectangles were excavated. One fragment of sun-purpled glass was found. An archeologist pointed out this glass might have gone down a rodent hole and might not prove the hypothesis. In 1987, a trench was excavated across the depression to a depth of 1.5 meters. Near the center of the trench at about 60 cm, a horseshoe and a fragment of cast iron were found. Several pieces of wire were found nearer the surface. No artifacts were found below this level. There was no evidence that the ground had been disturbed below this level.

The horseshoe, cast iron fragment, and wire supported the conclusion that this depression was what was left of a hole that was once about 60 cm deep. It was not a depression tramped out by the cattle or blown out by the wind.

MUSIC NOTATION TEACHING AID

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Hear it, Hum it, Sing it, but can you read it?
In schools today many young children start their musical education by learning to play a simple instrument, i.e. the recorder. The usual method of teaching the rudiments of music reading is to first introduce notes as letters and later introduce the notations on a stave. It is at this point some children become disillusioned by the new language and often opt out from their musical education.
I decided to produce a large scale representation of one stave of music in pegboard form, behind which is a series of 16 rearrangable switches, each representing one note. When each switch is activated by placing a note in the correct position, the pupil is rewarded and encouraged to continue and finish the simple 4 bar, 16 note tune.
The software program translates the notes on the stave into computer graphics and can be set to deal with an extensive number of elementary tunes. The pupil is rewarded throughout the process by visual and audible interpretations of the notes and tunes. This encourages and stimulates the child's musical interest and will support and reinforce the work of the music teacher. Research testing and evaluation was undertaken throughout all stages of my project at several schools in Sheffield. Feedback from pupils and teachers helped in the development of the final unit which has now been proved to stimulate and encourage the musical interest of all age groups learning music notations.

*Second Award - ISEF/Behavioral and Social Sciences

A THREE-YEAR COMPARATIVE STUDY OF MEMORY RETENTION THROUGH SUPPLEMENTARY SENSORY AIDS

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From 1985-1988 I have been working on an experimental investigation to determine the impact of visual and auditory cues in improved memory capabilities. To validate this, I devised two simple prose excerpts that would be presented to 877 4th,5th,7th,and 8th grade students as well as people ages 65-80. The 7th and 8th grade version contained 49 words, and the other experimental subjects used a prose passage with 45 words. The group was divided into five categories each receiving the passage on one of five colors-red,blue, green,yellow or white. The group on white paper served as the control for they were presented information strictly as facts and no visual stimulation in the way of color. A 2nd group was presented with a 48 word poem (7th and 8th grade) or a 46 word poem (4th,5th,and age 65-80.) The poem was on plain white paper and each subject kept in mind that memorization was the prime objective. A third group listened to a poem set to a simple melody. This study showed that the group presented with color did 52.96% better than the control group in 7th and 8th grades, 28.393% better in 4th and 5th grade students, and 19.03% better in age 65-80. For all groups the green presented the most improvement, followed by yellow, red, and blue. The group that incorporated rhyme did an average of 46.914% better (7th and 8th) and 46.34% better in 4th & 5th. The subjects ages 65-80 improved 18.91%. Melody was strong in the 4th and 5th grades with 53.06% improvement. Younger children were more receptive to the auditory aids, whereas older people were more effected by visual stimulation (improvement up to 400%) Many additional secondary experiments,practical applications, were run with all age groups with similar results. It can be concluded from this evidence that sensory aids are extremely influential in memorization. These tools if used correctly serve as enhancement in memory retention and can produce a large improvement in American classroom and the lives of senior citizens. Several schools are implementing the program I suggested using both visual aids (color) and auditory aids (rhyme.) The programs continue to show positive results with average test scores raising almost 30%. If used throughout life, sensory aids can prove to make memory capabilities endless.

*Second Award - ISEF/Behavioral and Social Sciences
Second Award - U.S. Air Force
Honorable Mention - American Speech-Language-Hearing Association

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"TWO-WAY WINDOW TO THE BRAIN"

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There's an old adage that says "I can read it in your eyes." Can a persons thought processes, attitudes, interests, and emotions "be read in the eyes"?

Can pupil size of an individual's eyes change as their attitudes, interests, emotions, and thought processes change?

To answer this question approximately ten tests were conducted. These tests involved the actual measurements of pupil size when various tests were presented to a select group of students. These tests included: pictures of subjects, colors, and words.

The main reason for the study of words is that while people seem to have characteristic responses to pictures, the individual's reaction to words are not very predictable.

All tests were conducted without the aid of artificial light. The only light accessible was dim sunlight filtered through tinted plexyglass. A millimeter ruler was used to record changes in pupil size during mental processing.

The largest dilation from a woman subject appeared in response to the word "squirm". The strongest constriction from a woman subject occurred in response to the word "hostile".

Pupil constriction resulted from the drab landscapes. In contrast, when subjects viewed pictures of opposite sex, pupil dilation always resulted.

Due to the nature of the responses, the conclusion made is that a person's pupils dilate with positive interests and attitudes while they constrict with negative interests and attitudes.

STAGES OF GRAY

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My project had three purposes. The first was to determine if kids at different ages are at different stages of moral development. These stages of mental development were discovered by Lawrence Kohlberg. My second purpose was to determine if males and females are at different stages of moral development. My third and final purpose was to determine if a person's stage of moral development affects his/her response to lying dilemmas. I tested 300 kids in grades 4 - 12 and made several conclusions. I found that older kids are at a higher stage of moral development than younger kids. I found that females are, on the average, at a higher stage of development than males. I found that stage of moral development has no effect on lying responses except in the senior high women. Finally, I concluded that Lawrence Kohlberg's methods are a valid way of determining stage of moral development.

*First Award - ISEF/Behavioral and Social Sciences
Honorable Mention - American Psychological Association

A SYMBIOTIC STUDY OF THE PEN SHELLS PINNA CARNEA GMELIN AND ATRINA RIGIDA (LIGHTFOOT)

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This study represents an attempt to describe the symbiotic association between the penshells Pinna carnea and Atrina rigida with the palaemonid shrimp Pontonia mexicana the fishes Astrapogon stellatus and Astrapogon punctilatus and the commensals crab Pinotheres maculatus in the shallow waters in La Parguera, Puerto Rico.

Sixty six Pinna shells were collected with 45 of them found harboring the shrimp for an incidence of infection of 65%. Ten Atrina shells were collected and 2 were found to harbor the shrimp for an indicence of infection of 20%. The same number of Pinna shells showed 15 to harboring the fish, A. stellatus for an incidence of infection of 22%. The same number of Atrina shells showed 3 infected with A. punctilatus for an incidence of infection of 30%.

Host specificity trials were conducted to test the preference of the shrimp towards its natural hosts. The two natural hosts, three controls three different geometric figures and colored pen-shells were also used to test for preferences.

Fear of Success in Adolescents

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The purpose of this study was to research fear of success in adolescents. The study was designed to analyze data results to see if fear of success differed dependent on the sex of the adolescent or on the size of school the adolescent attended.

Questionnaires were sent to fifty-three(53) Nebraska schools. A fear of success scale, a self-made scale, general questions, and questions concerning factors that could possibly influence fear of success were included. The questionnaires were scored and put into groups to be statistically analyzed.

From the data that has been analyzed it appears that females have a greater fear of success than males. Among the different school sizes there does not appear to be a significant difference in the motive to avoid success.

SPORTS PSYCHOLOGY: THE MENTAL PREPARATION OF AN ATHLETE

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Objective: To determine whether or not an athlete's attention span and mental capabilities will have an impact on the player's performance in athletic competition.
Hypothesis: There will be no significant correlation between an athlete's attentional and interpersonal style as it relates to his/her athletic performance. (A Null Hypothesis)
Procedures: Methods and procedures for this project begin with the gathering of data on previous studies which will have significance on my research. After collecting numerous articles, it is necessary to contact a sports psychologist in Oklahoma City (Dr. Dennis J. Moran) to advise me on the administration of this idea. The established means of testing an athlete's attentional style is the TAIS (The Test of Attentional and Interpersonal Style) and therefore I will need to examine data about the examination and the test itself. Then, I need to contact the basketball adviser at John Marshall High School in order to evaluate the possibilities of implementing this program with the Junior Varsity Basketball Team. After an agreement occurs according to the manner in which this project will be carried out, I will need to spend at least an average of fifteen (15) hours a week with the team, at practices and at games for a limited time span of three to four months. The objective of attending all of the games is to determine each player's field goal and free throw percentage for the season so that I can obtain a comparison group for the statistical analysis. The final step will be the statistical analysis using the Pearson Product Moment correlations in order to evaluate the relationship between the player's TAIS scores and their playing percentages.

*Honorable Mention - Federal Aviation Administration

* Effects of Sound and Light Distractors on Early Morning Vocalization in Cardinalis cardinalis

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Purpose: The purpose of this project was to explore the effects of sound and light distractors on the circadian rhythms of Cardinalis cardinalis, and to determine if, in the presence of natural light, the distractors were secondary zeitgebers.
Hypothesis: In the presence of natural light readings of EV values 9 2/3 to 11 2/3 (ASA 100K), sound and light distractors will interact positively with the primary zeitgeber, natural light, to act as secondary zeitgebers and provoke morning vocalization behavior in Cardinalis cardinalis before normal light values of EV 12 to 13.
Procedure: A control run was made for 9 days to establish degree of light at normal waking time. Four runs were done with each distractor. This data was analyzed to see the effect size each distractor had on waking time. Effect size was also tested on entrainment date to determine whether or not the distractors were effective entraining agents.
Results: The onset of natural daily song is provoked by a light intensity of E.V. 12 to 13 (ASA 100k). Distraction of the bird by light or sound is not sufficient to provoke a response if natural light is less than 9 2/3, but is sufficient to provoke a response if the natural light is between 10 and 12 E.V. units (sound - territorial response 26% earlier; light - normal response, 27% earlier). In the sound entrainment period response was 29% earlier, while in the light entrainment period response was 11% earlier. The sound distractor is an entraining secondary zeitgeber; the light distractor is a weak secondary zeitgeber.
Conclusion: Sound and light distractors do interact with natural light (E.V. values 9 2/3 to 11 2/3) to become secondary zeitgebers that provoke earlier morning vocalization in Cardinalis cardinalis.

*Third Award - ISEF/Behavioral and Social Sciences

A COMPARISON OF RESPONSES TO SPECIFIC AUDITORY DISCRIMINATION TASKS

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PURPOSE: The purpose of this project is to find if first grade students' ability to discriminate speech sounds (S.D.= Speech Discrimination) is similar to, or different than, their ability to discriminate music tones, rhythms, chords, and pitches (M.D.= Music Discrimination).
HYPOTHESIS: Students will perform differently on tasks requiring auditory discrimination of speech sounds and music presentations.
PROCEDURE: Fifty first grade students, (24 males and 26 females), were tested in two groups. After students were trained with practice materials, they were asked to tell if 40 pairs of taped speech sounds were the same or different, (tub-tug, wed-web, etc.) using the Wepman Auditory Discrimination Test. Then, they repeated this task while listening to 60 pairs of music presentations on the Selmer Music Guidance Survey.
RESULTS: Results from Group I (N=10) were inconclusive because of the small number of subjects. The average percent of difference between the two tasks was only 4.7%. The larger second group (N=40) showed a difference of 27.5% between speech discrimination and music discrimination scores. The combined groups showed a S.D./M.D. difference of 22.9%. Sex and age differences were studied but significant differences were not found.
The hypothesis was proved. The students performed differently (greater than 10 percent) on tasks requiring auditory discrimination of speech and music.
Possible future studies could include re-evaluation of the same students to check discrimination skills progress, expansion of handedness study, or tracing the progression of skills by testing different age groups.

THE RELATIONSHIP BETWEEN BIRTH ORDER AND SIBLING INTERACTION

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The researcher attempted to determine the relationship between birth order and sibling interaction of sibling pairs (ages 4-5 and 6-7). In order to obtain data, the researcher observed a random sampling of 20 sibling pairs engaging in a competitive and a cooperative task. Each task is six minutes in length and recorded on video. The tasks are divided into 20 second intervals in order to determine the frequency of each behavior. The behaviors occuring among less than 20% of the subjects are eliminated. To ensure interobserver reliability, the researcher and a psychologist observed the behaviors of a random sampling of ¼ of the pairs. The assesments are correlated using the ratio of agreements to agreements plus disagreements (a/a+d). Stability is assesed by observing a random sampling of ¼ of the pairs and re-observing the pairs two weeks later and correlating the assesments by the Pearson r correlation coefficient. Upon determining the inter-observer reliability and stability, the frequencies of each behavior for the first borns and the last borns are compared by analysis of variance. The researcher hypothesized that there is not a significant relationship between birth order and sibling interaction.

***First Award - U.S. Army**
Third Award - ISEF/Behavioral and Social Sciences
Honorable Mention - American Psychological Association

SEQUENTIAL MEMORY

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Problem: Which can students remember more easily: Sequences of numbers, letters or symbols? Is there a difference between males and females? Is age a factor? How does this study compare to other studies done on memory?
Procedure: Basic serial recall of sequences of number, letters and symbols were required of children ages 5-18 in grades K-12. Tests were given 2 days appart. In the first each series was presented visually for 2 min. and in the 2nd for 30 sec. Subjects then wrote down the series or arranged cards. Graphs comparing, ages, males and females were developed this year. Mathematical estimates of STM storage using Waugh-Norman formula and data from serial position curves were determined and comparisons done with other studies. Results: Females with few exceptions performed better than males on both tests. Retention of sequences did improve with age. (see graphs) The 2 min. test allowed time for strategies to be used. Natural Language Mediation could have been used to interpret sequences by older children (Adams '67) Younger children were not observed using rehearsal techniques (Burke'76) Primacy and Recency effects appeared on serial position curves (Banks '80). The symbol sequence was the most difficult to remember and the number the easiest. Cavanaugh '72 shows the same results listing in order of largest to smallest spans: digits, colors, letters, words, geometric shapes, random shapes, nonsense syllables. Waugh-Norman formulas showed maximum STM storage of 5 items just as Sperling '63 does.

*First Award - Federal Aviation Administration

A COMPARATIVE STUDY OF BEHAVIORAL AND PHYSIOLOGICAL CHANGES IN LAB MICE MAINTAINED ON DIFFERENT DIETING PLANS

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It has been found that repeated cycles of weight loss and regain result in increased difficulty of losing additional weight (Brownell, 1983). Dieting also results in increased anxiety and depression (Wadden, 1984).

The mice were divided into four groups: (a) control--ad lib food and water; (b) experimental group 1--80% of daily ration of food, ad lib water; (c) experiemntal group 2--.025mg Dexatrim/day in the water plus 80% food; and (d) experimental group 3--.0005g/day Nutrasweet in the water plus 80% food. The mice went through two cycles of 15-20% weight loss followed by a period of 95-100% weight gain. The following tests were run at the required weight loss and then repeated at the weight gain: resting metabolic rate, Rotarod, Voluntary Exercise, Intergroup Aggression, blood glucose, and Urine Metabolites.

In general, for a single bout of weight loss the 80% diet plan seems to be the most effective, for they had lost the most weight over the same time period and experienced the least adverse behavioral and physiological changes. The Dexatrim and Nutrasweet diet plans were ineffective because they experienced significantly lower levels of muscle coordination and voluntary exercise and elevated aggression levels. Repeated cycles of weight loss and regain make all dieting groups unbeneficial, because their bodies try to inhibit or protect against further weight loss by retaining such things as lower blood glucose levels and lower resting metabolic rates.

*First Award - ISEF/Behavioral and Social Sciences

SEX-STEREOTYPING IN 4 AND 5 YEAR-OLDS

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PROBLEM: Traditional sex roles in society are being challenged. The purpose of this research was to measure traditional sex-typing behavior patterns and parental influence on 4 and 5 year-old boys and girls living in Bountiful, Utah.
HYPOTHESES: In structured and unstructured play environments, does the perceived gender of a toy influence the play preferences of 4 and 5 year-old boys and girls to a different extent? Do requested and unrequested Christmas presents from parents instill traditional sex roles differently for boys and girls?
PROCEDURE: Eight groups of preschool children were studied. Play patterns with perceived gender neutral toys were measured and recorded. Following an announcement of the toys' gender, differences in play patterns and preferences were measured and recorded. All of the parentally-given Christmas presents to 20 children were itemized as requested and nonrequested. Seven adult judges categorized each toy by type and determined the toys' gender stereotypical appropriateness for boys, girls or both. Analysis was conducted on this data to determine the degree of sex-typed, neutral or cross-sexed presents both requested and nonrequested.
RESULTS: The gender announcement of the toys resulted in significant changes in the play patterns of both boys and girls. In the structured play environment, the intensity to switch was stronger among the boys; in the unstructured play environment, the toys' gender was more influential on the girls' play preferences. High percentages of requested presents were sex-typed toys; whereas, nearly 40% of nonrequested presents were sex-typed neutral. Girls received requested and nonrequested cross-sexed toys much more than boys.
CONCLUSION: The perceived sex of toys is a very influential factor in the play preferences of both boys and girls. Requested Christmas presents were judged to be more gender stereotyped than nonrequested toys. More than 75% of the measured and recorded sex-role behavior in 4 and 5 year-olds is consistent with traditionally defined masculine and feminine roles.

*First Award - American Psychological Association
Fourth Award - ISEF/Behavioral and Social Sciences

ANGULAR POSITION ESTIMATION UNDER CONDITIONS OF RESTRICTED FIELD OF VIEW

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The purpose of this project was to find out how well people estimate angles when different limits to their field of view are applied. It was believed that, as a person's field of view was restricted, he would lose angle estimation capability.

The initial test set up removed any visual clues in the test area. Safety goggles were modified with duct tape and cardboard cones to restrict the subjects's field of view to preset sizes. Ten subjects were tested with five different field of view restrictions. Each subject was shown objects at eight different angular positions and asked to mark the estimated angles in each field of view condition. The data indicated there is no loss of angle estimation capabilities under these different fields of view. The data demonstrate, however, that people do not estimate angles very accurately. At 15° positions (to the left and right of a straight ahead position), there was an average overestimation of 8°. The 30° positions showed an overestimation of 13°.

One potential application for this knowledge is in teleoperation of robots. While operating robots via camera, a trade-off must be made. If a smaller field of view is used, resolution goes up. However, there is a loss in the width of scene.

The results of this experiment show that a smaller field of view can be used without losing angle estimation capabilities.

*London International Youth Science Fortnight Trip - U.S. Navy
First Award - U.S. Air Force
Third Award - ISEF/Behavioral and Social Sciences
Alternate to Scholarship - U.S. Navy

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THE EFFECT OF SHAMPOOS ON THE FEEDING HABITS OF *MUS MUSCULUS*

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When research was done on mice's olfaction, it was obvious that mice have a keen sense of smell. There is significant evidence that shows definite links between odor and communication. Reproduction, dominance, identification, and aggression in mice are all controlled by odor. Logically, the difference between what is food and what is not would also be determined by smell. The mice smelled the hair as something eatable. The task was to see if this smell could be masked by a common shampoo currently on the market. A set of runs was made in a discrimination box to see what effect diffrent shampoos would have. Four shampoos were chosen, whose smells were on different parts of Jellinek's Schematic Arrangement of Odour Qualities. The idea was to see whether a smell type could incourage or discourage the eating of hair by mice.

PERCEPTIONS OF ANIMAL GENDERS

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Animals have great psychological meanings. Positive and negative, strong and weak, and aggressive and gentle connotations are attached to each animal. These connotations affect the way people perceive the gender of animals. But, do perceptions of animal genders change from youth to adulthood? Will males' perceptions of animal genders differ from youth to adulthood?

A survey of 60 students was conducted to assess their perceptions of the genders of 50 animals. Clearly, the majority of animals were perceived as male. Strong, aggressive animals were generally seen as male, while soft, beautiful or less threatening animals were considered female. But, once the students were divided on the basis of age and sex, differences in perceptions were noticed. Older females attach a sex to more animals. The animals are clearly male or female with few animals as neutral. Older males are just the opposite. Quite a few animals are clearly perceived as either male or female but there are also quite a few perceived as neutral. Younger students, both male and female, surveyed in the middle of the older students' results.

It seems as though males' outlook and perceptions of animals and animal genders are constant throughout life, while females start out with little differentiation between animals as male or female but as they grow older, drastically perceive more animals as either male or female.

YEAR THREE CORPORAL PUNISHMENT

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The purpose of this project is to determine if opinions on the use of corporal punishment can be changed by the presentation of fact.

A twenty minute speech was prepared giving both sides of corporal punishment. Three schools used in the first survey were contacted and agreed to have me speak to them at a parent/teacher meeting. At this meeting, a survey was taken before and after the speech, then analyzation of data began.

The results have showed positive changes in opinions after the presentations. I have concluded that if the public is made aware of corporal punishment, its history, religious connection, abuses, court cases and other facts, they will be able to determine for themselves whether or not corporal punishment should be used in schools and not just depend upon old customs or beliefs.

During my third year of research, I attended a conference on corporal punishment and a child abuse symposium.

Now, I will begin working with teachers on applying the various alternatives in classroom situations. I will also attempt to have it abolished from the state of Louisiana.

THE BILINGUAL LEXICON: A SHARED CONCEPTUAL SYSTEM OR TWO SEPARATE REPRESENTATIONS?

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My three part experiment was designed to study the representation system of the bilingual. The purpose was to determine whether the bilingual has a common conceptual systsm or representation for both languages, or two separate conceptual systems, one designed for each language. I hypothesized that there is one shared conceptualization as opposed to two distinct systems. The first phase of testing consisted of a questionnaire designed to acquire personal information about the subjects, and to determine their level of bilingualism. The second phase of testing consisted of a word recall, tested using original English words and French or English repetitions of some of the original words. The third phase was the administration of a bilingual version of the Stroop colour-word test. These phases were designed to determine whether French & English words are part of a common lexicon, and therefore part of a shared representation, or if the two different languages belong to two separate conceptual systems that can function independently of each other. Computerized analysis of the results indicated that there is a single shared conceptual system common to both languages of a bilingual. In phase two, words said in English and/or in French, functioned as the same in the mind of the bilingual. In phase three, subjects found it impossible to operate in one language only, free from the influence of the other. The results of my testing indicate that the English/French bilingual lexicon is based upon one conceptual system, common to both languages.

#Second Award - American Psychological Association
Third Award - ISEF/Behavioral and Social Sciences

WHAT YOU SEE IS NOT ALWAYS WHAT YOU GET

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Does subliminal suggestion work? This project shows that subliminal techniques are an effective method of influencing consumer preference. Several hypotheses about subliminal persuasion were developed.

One hundred-five high school and college students were given a pretest to determine food preferences. They were divided into six groups: environmental, control, raisin word embed, raisin picture embed, candy word embed and candy picture embed groups. Two weeks later they viewed a one-minute videotape on raisins containing subliminal embeds and completed another survey of food preferences. Both descriptive and inferential statistics were used.

The results demonstrate several things. First, the videotape alone had a powerful persuasive influence. Second, a positive subliminal embed had a slight positive influence and a negative embed had a slight negative influence. The data suggest that a subliminal pictorial stimulus is more effective than a subliminal verbal stimulus. Its also shows that males may be more responsive to subliminal stimulation than females.

The data support the weak claim as stated by Moore, that subliminal suggestion will only slightly sway consumer preference, but not totally reverse it. The popular Belief that subliminal persuasion can compel people to dramatically change their behavior is not supported by these data. The topic of subliminal persuasion requires further research with a larger sample size to support or refute the strong claim theory.

#Fourth Award - ISEF/Behavioral and Social Sciences
Honorable Mention - American Psychological Association

DEVELOPMENT OF SOCIAL HIERARCHY BY AGGRESSION IN CRICKETS

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The purpose of this project was to determine if a pattern of dominance existed with the insect population, and the reason for this dominance. By pairing male crickets, it was possible to record the level of intensities using Alexander's rating of aggression in crickets. Each pair was matched two times for a total of fifty encounters, and the winner was recorded for each match. After all crickets had been paired together, the crickets were ranked from dominant to subordinate. When all five crickets were then placed together, the most superior cricket established his home as a corner and allowed only the most subordinate cricket to enter. This dominant cricket received the most space and the food that was offered in the second set of experiments. These results proved the hypothesis showing that dominance has an effect upon the distribution of food and that crickets establish a social hierarchy which determines food dispersal. In the third set of experiments, it was necessary to prove that the individual spacing was based upon territories instead of random spacing. Using the equation that randomness is equal to the mean of the measured cricket distance over the mean of the expected distance, a value of R was determined. Because this value was over one, the dispersion was not random and the crickets showed a regular dispersion. The dominance and aggression is a provision in the environment not only for food and space dispersion, but also for reproduction.

*Third Award - ISEF/Behavioral and Social Sciences

STUDY ABOUT THE EFFECT OF MUSIC IN PSYCHOLOGY, PHYSIOLOGY AND HUMAN BEING HEALTH WITH ESPECIAL ATTENTION ON TROPISM OF PLANTS DURING TWO YEARS.

Pagan, Jesse. Francisco Rodriguez Lopez H.S. ; Guayanilla, P.R.
Dr. M. A. Zavala 113; Guayanilla, P.R. 00656

The purpose of this investigation was to observe the effect of music therapy on the behavior and health of human beings and observe the effects of differents types of musics on plants germination and tropism. I formulates 500 interviews from which I handed 250 in Yauco and 250 in Guayanilla to observe musical preference. Then I dedicated myself to make an exerxise on music therapy using the types of music chosen by 500 students inquired to observe which of these types affect positively or negatively psychology, physiology or human health, besides observed the effect of this music in plants tropisms. During the phase 1, I observed the effect of different types of music on animal behavior. During the phase 2, I observed the effect of music therapy in psychology, physiology and human being health. The doctor did the analysis of blood pressure. I observed and collected data. During the phase 3, I observed the effect of different types of music on the plant germination and tropisms.

The conclusion of phase 1 is that rock music alters the nervous sistem and affect animal behavior. The classic music does not affect negatively the nervous sistems or behavior of them. In phase2 the conclusion is that the rock music produces a pronounced effects, but variable in the pulse, blood pressureand in the endocrine function and accelerates breathings or alters its normal activity. The classic music can be used to encourage learning and tends to reduce and delays fatigue, and consequently increases muscular hardening. In phase 3 the conclusion is that the different types of music accelerate the germination and affect plant tropisms.

Music: NEW ALTERNATIVE FOR THE SCIENCE AND THE MEDICINE OF THE FUTURE

DO CERTAIN CHEMICALS CAUSE ACTIONS LEADING TO VIOLENCE?

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This project consisted of a two year study involving two phases. The first phase included an experiment designed to test the hypothesis that the introduction of certain chemicals into the body may trigger reactions leading to violent behavior. Mice were used as the experimental subject. They were divided into four groups consisting of four mice in each group. The groups were organized as follows: a control group(group A), a group that was fed glucose(group B), a group that was fed alcohol(group C), and a group that was injected with the amphetamine Tenuate(group D). Phase two continued the study in search of specific biological and chemical reasons why observed aggressive behavior occured. The conclusions of this research confirmed the hypothesis. Of the three chemicals tested, alcohol produced the most reactions leading to violence.

A MALE AND FEMALE RED PANDA IN TWO CAPTIVE ENVIRONMENTS

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Mound-Westonka H.S., Mound, MN 55364
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ABSTRACT. Activity patterns and feeding behaviors of an adult breeding pair of red panda (Ailurus fulgens) were observed in a quarantine area and in a new outdoor enclosure. Individual differences were found in feeding behaviors. The male and female showed opposite food preferences for bamboo and gruel. Both animals preferred grass when available in the new enclosure. Behavior patterns varied between the male nad female and also between thw two enclosures. The pandas were found to spend more time out of the nest boxes and engaged in other behaviors in early evening versus morning observations.

Drosophila Melanogaster- Oviposition Preference

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Drosophila melanogaster oviposite in many and various fruits (Davila, I, 1985). In this research some fruits were exposed to the environment and in which of these fruits the fly preferred to oviposite was proved. Using for these the numbers of flies that rose from each fruits as representative of the number of eggs that were oviposited.

The fruits were exposed to the environment for four days and they were separated in different glass bottles. The flies that surged were counted and classified the D. melanogaster, with the use of the taxonomy key of the Drosophila gender in Puerto Rico.

The results show that D. melanogaster of the selected fruits, prefers to oviposite in the grapefruit. During the second year these results allow the researcher to show that the presence of other species of Drosophila affects the oviposition place of D. melanogaster.

*Honorable Mention - American Psychological Association

DOES CEREBRAL DOMINANCE AFFECT MATH EDUCATION?

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How is the degree of comprehension and the success rate in math education being affected by cerebral dominance? If mathematical development is being affected by cerebral dominance, can this factor be minimized with alternate teaching strategies?

It is hypothesized that cerebral dominance is affecting math education. The degree to which this factor is manifested in each individual varies, but it is believed that cerebral dominance has a definite effect on comprehension, overall success, and self-confidence.

All subjects were screened for cerebral dominance prior to participating in the experiment. One hundred high school students completed the TORRANCE, REYNOLDS, BALL, AND RIEGEL written test for cerebral dominance. They answered questions on their mathematical experiences in relation to cerebral dominance. The tutor sessions involved three children, ages nine, ten, and ten. The individuals were screened for cerebral dominance using hand, eye and muscle dominance, observations, and questioning. They received instruction specifically designed for their hemispheric specialization. Observations were made and data was collected to evaluate progress.

In addition to experimentation, correspondence with researchers in the United States, Canada, and the Philippines has reinforced the hypothesis. Cerebral dominance is having a definite effect on math education. It affects learning preferences, types of errors made, grades in the class, and self-confidence. Cerebral dominance does not have to be a limiting factor. Understanding the thought process and using skills from both hemispheres in teaching are effective steps toward making cerebral dominance a positive factor in the classroom.

THE EFFECTS OF FIVE DIFFERENT STIMULI ON HUMAN MOTOR RESPONSE TIME

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This project observes the effects certain stimuli have on the central nervous system. This is accomplished by placing a yard stick next to the ball of a subject's foot. A marbel was then dropped from different heights. When the subject couldn't move his foot before the ball hit it; a record was made of that distance. The distances were averaged. The averages of the inches the ball hit the subjects were converted into hundredths of a second. Subjects were then exposed to various stimuli and the results were observed and recorded.

In Phase I, males' response times were faster than females', and children were faster than adults. In Phase II, it was observed that alcohol in any form slowed human response time. In Phase III, classical music had the least effect on response time, while hard rock increased response time the most. Phase IV, showed that exercise improved response time of males ages 13-15, after 10 and 20 minutes, but after 30 minutes the response time began to decrease. In Phase V, caffeine was found to improve response time the most, with non-caffeine improving response time in a small amount.

The hypothesis of Phase VI, is based on the belief that four different drugs (Advil, Tylenol, Bayer, and Bufferin) will increase or decrease response time. Results revealed that all four drugs improved response time, with Bayer improving response time the most, then Tylenol, Bufferin and finally Advil.

*Honorable Mention - American Statistical Association

ARTISTIC DEVELOPMENTAL STAGES OF CHILDREN

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The purpose of this study is to determine the subject matter most drawn by children between the ages of five and fourteen, and to determine if the subject matter most drawn differs between boys and girls. This study will also show different artistic developmental stages of drawing that they go through.

Approximately five hundred children from the ages of five and fourteen were chosen and asked to draw their favorite picture. After they drew the pictures, the pictures were gathered and carefully examined and placed in specific categories of analysis depending on the subject matter of their picture. The subject matter categories are as follows: men and women, house, animals, sports, forms of transportation, plant life, airplanes and rockets, hearts and rainbows, logos, designs, and holidays.

The results do indicate that children do draw different subject matter. The subject matter most drawn by children between the ages of five and fourteen was people. The second subject most drawn was plant life; third - houses; fourth - animals. The subject matter also differs between boys and girls. The subject matter most drawn by boys is people The second subject most drawn by boys was sports; third - houses; fourth - animals. The subject matter most drawn by girls is plant life. seond - people; third - animals; fourth - houses.

We can comlude that children between the ages of five and fourteen do draw different subject matter depending on age and sex of the child.

*Fourth Award - ISEF/Behavioral and Social Sciences

VIDEO TEACHING VERSUS HUMAN TEACHING

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I conducted this experiment to see how video teaching compared to human teaching affects the students and their learning abilities. I used grades one, three, and five. There was about 110 students. To conduct this experiment, I tested the students with two worksheets from each subject - reading and math. I taught the students in the classroom with one worksheet of math and one of reading. I made a video tape of myself and I did the same with the worksheets. My actual instructing was about two - four minutes long. The students had approximately ten minutes to do the worksheets. I based my results on the grades the students got and their reactions. I also compared the grades to each other, and I compared boys to girls in each category. According to my results, video teaching compared to human teaching affects the students according to their age and the subjects they are being taught. On the math worksheets, the students did better after viewing the video tape than when I taught in the classroom. On the other hand, on the reading worksheets, their grades were about the same or lower after they viewed the video tape than when I taught in the classroom. The first graders got the same or higher grades after viewing the video tape in both subjects. The third and fifth graders were higher in math after viewing the video, but their reading grades were higher after I had taught. Overall, the girls got slightly better grades, and they were also more excited about the project. According to "Video Teaching versus Human Teaching," the effects of video teaching compared to human teaching depends on the subjects being taught and the age group being taught. Although this is true, I feel that human teaching is more effective.

MORE THAN MEETS THE MIND

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What are the variations in encoding techniques used by students to retain information? It is hypothesized that there is a large difference between the types of learning processes used. It is also believed that by coupling two techniques together it further enriches the learning ability of the student. However, by letting visual encoding compete with touch encoding it slows down the process of learning and reacting. A series of six tests are performed on each student used in the experimentation. Two tests examine the use of the visual technique; two tests examine the audio technique; and two tests examine the use of the possible touch technique. The tests include the Picture Test and the Hand Test. Each test is divided into three subtests; namely visual, audio, and touch. The results of each test are compiled in two different catergories: sex and dexterity. All tests are evaluated to determine the one technique used most successfully by the students. It was found that students preferred the touch technique for accuracy and reliability. The acute correctness of their replications supported this choice. As a whole, the population of students tested scored better in the touch techique. In relation to the male and female categories, both sexes had quicker response times in the touch subtest of the Hand Test. When divided according to dexterity, both the left- and right-handed individuals responded quicker in the touch subtest also. These results substantiated a long held belief that "hands-on" activities enhance learning in the classroom.

*Honorable Mention - American Optometric Association and Auxiliary to the American Optometric Association

COMPARATIVE STUDY OF POSSIBLE HALLUCINOGENS AND THEIR EFFECTS IN THE BEHAVIOR OF MESOCRICETUS AURATUS: SPECIAL EMPHASIS ON 'PANAKOLUS SPHINCTRINUS 'AND 'DATURA ARBOREA '

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During the lapse of the first two years of research we are concentrated in the study and analysis of the effect of the 'Panaeolus sphirctrirus' fungus and other three drug substitute on the behavior of 'Mesocricetus auratus'. To accomplish this we realize observations during 72 hours, and others types of basic test to determinate the possible changes on the behavior of the animal. From these test submited to statistic analysis we can infer and diagnose the basic effects that these substitutes cause on the behavior of the animal. Also we could establish a comparison between the effects of the different kind of drugs, on the animal's behavior.

The certainty of analysis and study of and unknown substance is not only observing the primary effects cause by this, but analysing the possible effects of this substance on the future generations of those that had taken this substance. Noticing this preocupation we had realize our new investigative phase, in which we will study and analize the behavior of three generations of 'Mesocricetus auratus' which its parents had been exposed to the effect of some drug substitute.

*Fourth Award - ISEF/Behavioral and Social Sciences

BIRTH ORDER AND SELF-IMAGE

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The purpose of this study is to verify the effects of birth order on self-image in adolescents. Birth order or ordinal position is the position in which the child appears in the family constellation: oldest child, middle child, youngest child, or only child. I chose this project because I am intrigued by family environment and its effect on the individual. I chose to base my study on adolescents because, being one myself, I am interested in the processes of their minds and emotions.

The Offer Self-Image Questionnaire for Adolescents (OSIQ) was obtained from Michael Reese Hospital and Medical Center. Three studies were performed on sixty-six adolescents using edited and unedited forms of the OSIQ. The three studies were conducted on adolescents from three different school environments: an urban public high school, an urban public elementary school, and an urban private high school. The questionnaires were manually scored by scale.

Overall, the results of the three studies did not comply with the traditional birth order sequence or with the variables of birth order. It is difficult to draw many strong conclusions because the limited size of the sample (especially for the only child) brings the validity of the results into question. At the same time, it gives a basic idea of the pattern of self-image for a "normal" adolescent. Compared with last year's results concerning positive social relationships, it is apparent that birth order has a stronger effect on the external aspects of the personality than on internal aspects, like self-image.

***Fourth Award - ISEF/Behavioral and Social Sciences**
Honorable Mention - American Psychological Association

NAVAJO-ENGLISH DIALECT

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Many Navajo speakers of English on the reservation are making the same grammatical and syntactical errors even though age levels and academic experience varies. This may indicate that a Navajo-English dialect is forming. To verify this, I plan to test twenty-five students each in grades three, six, and nine for different morphological and syntactical constructions using the Clark-Madison Test of Oral Language. I obtained permission from school administrators and tested each student individually. I tabulated and organized the data into the different grammatical groups. Through my testing, I determined that there are thirty-five different errors that are significant at all three grade levels. If these errors were developmental, most of them should have disappeared before the child reached middle adolescence. Because they do not, I concluded that they are an indication that a Navajo-English dialect is forming on the reservation. This information can be used in educational processes for Navajo students. By recognizing appropriate uses of the dialect while contrasting it with Standard English and teaching the need for both, perhaps students can see the reason for the more conventional usage while still valuing the ethnic and cultural aspects of their unique way of speaking.

***First Award - American Speech-Language-Hearing Association**
First Award - U.S. Navy

MEMORY: AUDIO OR VISUAL?

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Purpose: This research project was conducted to determine whether students at the Bartlesville Mid-High School remember more with visual or auditory stimuli. It also sought to discover whether teachers at the Mid-High use more auditory or more visual instruction in the classroom. The overall objective was to see if the students are being taught in their best learning style.
Hypothesis: Of the students tested, a greater number will memorize better with visual stimuli. Of the teachers surveyed, a greater number will teach to the auditory learner.
Procedure and Materials: To obtain research for this project, 154 students, both freshmen and sophmores, were given an auditory-visual test to find their best learning style. In order to determine the number of teachers who teach more visually or teach more verbally, 38 teachers also completed a survey. Materials used in this study include: an overhead projector, stop watch, tests, and surveys.
Results: Of the 154 students tested: 109 have a better visual memory, 37 have a better auditory memory, and 8 students have an equal auditory and visual memory, making the first part of the hypothesis correct. Of the 38 teachers surveyed: 13 teachers teach with more visual instruction, 11 with more auditory instruction, and 14 teachers teach with an equal amount of auditory and visual instruction. This made the second part of the hypothesis incorrect.
Conclusion: After examining this project's results, it seems that the majority of students at Mid-High have a better visual memory, and are being taught to their best learning style, visual.

*Third Award - American Optometric Association and Auxiliary to the American Optometric Association

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EFFECTS OF EXTREME LEVELS OF TEMPERATURE ON THE BEHAVIOR OF ANOLIS CRISTATELLUS

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One of the most abundant reptile species found in Puerto Rico is the Tree Lizard. Although unpleasant for the majority of our population, it helps to eliminate harmful insects to man, flora, food and household pets.

With the purpose of expanding available information about the effects of temperature on the behavior of the genus Anolis cristatellus, a group of forty specimens of both sexes (twenty males and twenty females), was subjected to observations during a forty days period (twenty days for each sex), under conditions of temperature levels of 40° and 10°C respectively. The expositions to heat and cold were carried twice a day for fifteen minutes (6:00 - 6:15 A.M. and P.M.) on alternating days.

Male Anolis showed more active behavior than females during expositions to high temperature (40°C). Under low temperature (10°C), both sexes showed similar inactive behavior.

From the observations that were carried out, it may he asserted that environmental temperature indeed exerts influence on the visible behavior of certain species of reptiles, as is the case of the Anolis cristatellus.

More investigation is needed in the area of tolerance to low temperature.

REPORT OF THE POSSIBLE EFFECTS OF *ALPINIA ZERUMBET* ON THE BEHAVIORAL PATTERNS AND REPRODUCTIVE SYSTEM OF *CAVIA CCBAYA* AND *MESOCRICETUS AURATUS*

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The *Alpinia zerumbet* plant (Burtt & Smith) belongs to the family of Zingiberaceae. It is mainly known as "dragon" or "boca de dragon". It is characterized because all of its components have a fragant aroma, especially its flowers. In P.R. it is used by people in teas for asthma, bromchitis and other illnesses.
Throught this work we pretend to study the possible changes that the aqueous extract can generate when given in different concentrations to the *Cavia cobaya* and *Mesocricetus auratus*. Changes in the behavioral patterns and reproductive systems were observed.

The behavior of the female and the male specimens was studied using 6 ccnsecutive periods finding 14 different possible behavioral patterns. The behavior test reflected that no matter the concentration, the 4% flower, 25% and 50% rhizome there are always going to be significant changes. According to the test carried out we can deduct the most frequent change were 2 (investigate), 8 (grooming), 10 (drinking), 13 (fecal deposition), 14 (urinary incontinence), 5 (head or body shake). The rest of the patterns can increase of decrease in frequency.
Other behavior test carried out such as running the habitrail express, balance, sphere test, dark and light test, muscular coordination demonstrated that the animals had difficulty in returning to their normal positions.

The histological study demonstrated that in the testicles at a concentration of 25% rhizome it was observed that there were many empty spaces between cells. At the same time dead sperms were found while analizing the tissues.

JUVENILE DISTRESS Phases I-IV Effects of a stressfule family environment on the academic growth of the adolescent, Gustavo Arrizabalaga

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There are a lot of studies about adolescents where their problems and the possible solutions are stablished.In all of them it is mentioned the posibility of family problems being the base of all the other situations that affect the adolescent.But it is difficult to find a study that looks for that relatioship in a more direct way.In phase III of this study I present a list of the symptoms and the problems that are stressors according to the level of affection of each one.The results show that lowering school grades is the stressor that most affects the students from 8th to 10th grade with an affection level of 68.8 in a scale from 20 to 100. Through a longitudinal study(Phase VI) of a sample of students of 8th grade it could be seen the extent to wich family problems can affect the grades of the adolescent.For this study the academic trajectory of the adolescent since he started studing was evaluated taking into account a questionaire that provided information about the family problems and their influence on the academic growth.Through my investigation I have been able to prove that some of the adolescents that claim to be affected by low grades are actually victims of family problems.It is the objective of this study to present the family problems as the posible source of the bad academic growth of the adolescent in order to make the education system and the family aware of this problems that opresses our adolescents.

RIGHT AND LEFT PAW DOMINANCE IN CATS

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There has been extensive use of the domestic cat in medical experiments which require the cats to manipulate objects with a paw. It has generally been assumed that there is little or no paw preference in cats and consequently that paw dominance has no significant effects on such experiments. However, right and left paw (hand) dominance is not unique to humans and has been traced from man through the primates to lower vertebrates such as the mouse. The cat has not been studied for this trait.

Paw dominance in cats was demonstrated by modifying a cat toy so that retrieval of rewards from inside the toy could be made physically easier from the left or the right. Four cats were observed to determine to what extent a cat would remove rewards with a preferred paw even when the task was physically easier with the opposite paw. Two of the four cats used a preferred paw 10 retrievals out of 10 ($p=1/1024$) when the test was biased to the right or to the left. When given a choice, the same two cats chose (10 out of 10) to retrieve rewards from the side which was physically easier with their preferred paw. A third cat showed a weaker paw preference, and a fourth cat showed no paw preference at all.

The two cats out of four with a strong paw preference (1 left, 1 right) suggests that paw preference in cats is a factor which should be considered in the design of experiments involving cats.

***First Award - American Veterinary Medical Association**
Fourth Award - ISEF/Behavioral and Social Sciences

FACTORS IN LEARNING

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This experimental investigation was constructed to determine the differences between Chunking and Meaningfulness, two major factors in the process of cognitive learning.

For my experiment I conducted an educational survey over the 7th,8th, and 12th graders.For my first procedure I distributed a set of index cards to half of the students that contained words grouped into related units by the use of the Chunking method .the other half were given the same words without the method.Similarily,I handed out another set of index cards,half with the use of Meaningfulness,the other half without.for the second step in my procedure I again handed out a first set of index cards,half of them with the use of the two factors the other half without.the differences between these two procedures is the amount of words and the timelapse.Based on my results and conclusions I found that even with a difference in the amount of words and time lapse the efficiency of learning by Meaningfulness and Chunking under the conditions which I tested is higher than that of without,with Meaningfulness showing a higher rate than Chunking even though Chunking has a positive effect on learning.

Therefore based on the results of this experiment, to provide for optimal learning,words should be given in a context at one,Meaningfulness than Chunking.

SOCIAL INTERACTIONS AND RELATIONSHIPS IN A PACK OF YEARLING CAPTIVE WOLVES

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A pack of six yearling wolves (Canis lupus) was studied at the Minnesota Zoo in order to determine social relationships among pack members. It was hypothesized that the pack would have a differentiable hierarchy at the young age of one year and play preferences would be among littermates. The all-occurence sampling method was used to record data on dominant, submissive, and affiliative behaviors, noting actor and recipient. The pack is found to be generally nonaggressive in nature, with over 67% of the social interactions involving affiliative behaviors. Individual play preferences are found among littermates. The present dominance hierarchy is determined and found to be linear with all amles ranking above all the females. Research supported by the Minnesota Zoo.

***Second Award - ISEF/Behavioral and Social Sciences**

DOES EXPOSURE TO COLOR AFFECT COLOR PERCEPTION?

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Fifty students, 25 male and 25 female, were tested to determine the effect of sex and quantity of experience on the ability to perceive slight variations of color. Six tests were administered to each student individually (three primary and three secondary colors). The tests required matching three color swatches to the pure form of each color. One of the swatches was identical to the color in the standard (in a petri dish), one was slightly lighter and one was slightly darker. The variations in lightness and darkness were controlled quantitatively. The students were given ten seconds to decide which of the swatches matched the standard color. The test results consisted of percentages of correct and incorrect matches between the color swatches and the standard. Females had a slightly superior color perception. The art instruction, or artistic ability, resulted in a definite enhancement of color perception. Combined scores of the sexes show that students that hadn't received art instruction got 62% of the tests correct, and students that had taken four years of art got 84% of the tests correct.

TUNES & TESTS: THE EFFECT THAT MUSIC HAS ON TAKING TESTS

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For years sociologists, education specialists, and students have been trying to answer the question if music affects one's ability to concentrate and learn. Therefore, the purpose of the experiment was to determine the effect that music has on one's ability to score well on a simple math test, using classical and rock music as independent variables. It was hypothesized that rock music would have the greatest negative effect on one's ability to score well on a math test.

Giving each of twenty high school students four minutes to complete each test, they were scored on the number of problems attempted, the number of problems correct, the percent of the number of problems attempted, and the percent of the number of problems correct. Actual numbers, percentages, and averages were recorded as data.

It was concluded, after research had been completed and comparisons of the results had been made that music has no significant effect on one's ability to concentrate while taking a test.

***Honorable Mention - Acoustical Society of America**

DOMINANCE AND FAVORITISM IN MALAMUTES

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My hypothesis was that, under separate living conditions, a pack of Malamutes would show a system of dominance and demonstrate favoritism. I formed this hypothesis by everyday observance of the pack.

The purpose of this experiment was to gain a better working knowledge of my dog sled team. It would also give me insight into their behavior and how they interacted with one another. I feel that this information will be useful to other team owners and even to owners of dogs as family pets since it could aid them in handling and training their own dogs.

I conducted several experiments to test favoritism and dominance among my pack of dogs. Most of the experiments went as I expected, although some problems were encountered with the aggression between two of the male dogs.

My hypothesis was proven during the ten months I observed the Malamutes. It showed a strong pecking order, which was easily discerned. I feel the data I collected will be of great help to me in the management of my team, as well as an aid to other dog owners.

My conclusions are that there are dominant dogs in this pack who fit a list of general characteristics and must fulfill certain responsibilities within the pack. As an observer and in the time I witnessed the Malamutes' behavior, I saw favoritism shown between a mother dog and her pups.

REWARD STIMULI AND COMPUTER ASSISTED INSTRUCTION

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The purpose of this project is to investigate the results of using Computer Assisted Instruction and compare reinforced and non-reinforced

Two programs were created; one with reinforcement and one without. 12 fourth grade students ran the demonstration then two practice quizzes. Then the procedure was repeated followed by a final paper test. The same procedure was used with the control group, but substituting worksheets for the computer tutorial.

This investigation showed that the group reinforced program remembered 74.4%. The group that used non-reinforced program got 59.2% correct. The control group remebered 38.3%. The girls using the reinforced program remembered 78.3%. While non-reinforced only 50% correct, while the control group remembered 23.3%. The boys using the reinforced program remembered 70%. The group that used the non-reinforced got 82% correct. While the control gorup remembered only 53.3%. The girls seemed to benefit from the reinforced more that the boys.

The students running the reinforced program remembered the most shapes. While the students running the non-reinforced program remembered fewer shapes. The control group, using paper practice, remembered the least.

Thus, this study supports the idea that Computer Assisted Instruction, with immediate positive reinforcement, could lead to greater retention. Further study could be done with other aged students and with more complex programs.

A TWO YEAR STUDY OF THE EFFECTS OF WINE COOLER

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The first year study researched the effects of wine cooler on physical appearance, mental and motor responses of consumers. The results of the study showed that excessive consumption of wine cooler had marked effects on the behavior and appearance of smaller animals--hamsters. The second year research studied the effects of excessive wine cooler consumption on individual and group behaviors of larger animals. The study also sought to determine whether the non-drinkers would become drinkers when placed with drinkers and given a choice between water and wine cooler.

The problem was researched in seven phases using ten randomly selected male Rattus albinos. The phases included observation of the animals on water only, wine cooler only, and finally both water and wine cooler for the test animals and also for the mixed groups.

The results of the study showed that no significant difference existed between the control and test animals. The results also showed that one albino developed a preference for wine cooler and that three nondrinkers did drink wine cooler when placed with drinkers. A comparison of both studies suggested that short term excessive use of wine cooler may not be as debilitating to larger consumers as overuse of this beverage may be to smaller drinkers.

*Third Award - American Psychological Association
Third Award - ISEF/Behavioral and Social Sciences

THE RELATIONSHIP BETWEEN EYE-HAND COORDINATION, READING, COMPREHENSION

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The purpose of this project is to determine if there is a relationship between eye-hand coordination, Reading Comprehension, and Visual Acuity. To determine this, this researcher first identified two groups of students, half honors students and half remedial reading students. They were all given the M.A.T. prior to my study. This researcher then gave them all eye-hand coordination tests and video taped their eye motions while reading a short narrative. Test subjects then played a video game designed by this researcher for a period of two weeks. Then they were given a post reading comprehension test and a post eye-hand coordination test. This researcher then video taped their eye motions again and looked for improvement in reading comprehension scores, eye movements and eye-hand coordination scores.

*Second Award - Federal Aviation Administration

PROBLEMS OF ADOLESCENT STUDENTS WITH DIVORCED PARENTS

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A survey was given to high school students to study differences between students from divorced families and students from nondivorced families. Divorced students are hypothesized to have more problems in three separate areas: academic variables, depression, and financial status. Specific academic hypotheses are that divorced students will have a lower grade point average, that grades would have dropped at the time of the divorce, that they will like their teachers less, and that they will like school less. On depression variables, divorced students are specifically hypothesized to feel depressed more often, to feel they will not be good parents, and to be involved in more depressive acting out with school behavior problems, more rebelliousness, and more likelihood to smoke, drink, and try drugs. Divorced students are hypothesized financially to feel that money is tighter and that they will less likely attend college.

Survey data was collected from 446 students from two local high schools. A Chi-square analysis was run on the differences between the divorced and nondivorced groups. Significant results were found for one depression variable (divorced students felt that they would not make a good parent themselves), one depressive acting out variable (divorced students were much more likely to have tried drugs), and one financial variable (divorced students were more likely to feel that money was tight). Differences between data in the first-year study that had reported some major academic differences and this second-year sample are discussed. Conclusions are that more help needs to be given to students with problems of divorce.

*Fourth Award - ISEF/Behavioral and Social Sciences

FACTORS THAT AFFECT LEARNING

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The purpose of this project is to determine how good a person's memory is, and what factors, if any, affect that person's memory. This was done through a series of eight tests. Test I evaluates visual short-term memory by using advertisements. They are shown to the test subject and questions pertaining to them are asked. Test II is an already prepared test which evaluates short and long term memory. Test III uses a video tape, shown to test subjects, to test the ability of visual short-term memory. Test IV involves the remembering and recall of three letters and three words while being distracted as the letters and words are being learned. Test V requires the test subject to recall as many words as possible from a dictated list of twenty. Test VI evaluates the ability to recall sets of numbers in series. Test VII uses color cards in an effort to determine if color affects the recall of words and numbers. Test VIII considers music, silence, and noise as possible factors that will affect learning. The test subjects are required to learn a set of words and their definitions under each condition. In conclusion, subjects remembered words and letters better than numbers, did better with the color red, and recalled more information while listening to music.

HOW ARE FEMALE ADOLESCENTS' GRADES AFFECTED BY THEIR REACTIONS TOWARD PHYSICAL MATURATION

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The purposes of this study were to determine: (1) if girls have a negative, positive, or neutral reaction toward the menarche, (2)if the menarche has an effect upon girls' academic performance, (3)if there is an effect, is it related to the girls' reaction toward the menarche, (4)if there is a difference in reactions of those girls' who had been prepared to those who had not been perpared, (5)if the girls' reactions toward the menarche may have been influenced by the way in which they were perpared, (6)ideas of how the subjects might, in the future, prepare their daughters for menstruation. It was hypothesized that: (1) girls have a negative reaction toward the menarche (2)the menarche has an effect on the girls' academic performance, the effect is negative, (3)the effect is related to the girls' reaction toward the menarche, (4)there is a difference in the reaction of those girls' who had not been prepared in advance, (5)the girls reaction were influenced by the way in which they were perpared.

Adolescent female subjects were given a questionnaire. Pre- and post- menarchal grades of each subject were obtained by the school counselor. Names of subjects were removed to ensure confidentiallity of the subjects. Data was then analyzed and recorded.

The 1987-88 showed the majority of the subjects grades did decrease and also showed neutral reaction. The past 1984-85, '85-86, and '86-87 studies also showed that the subjects academic performance was effected by their reactions toward physical maturation.

INVESTIGATION INTO EYE-HAND COORDINATION

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The main objective of this investigation was to see if light, temperature, sound, and various combinations of these three stimuli would alter eye-hand coordination. The idea for this investigation came to me while I was studying reasons for car accidents. I wanted to find out if certain environmental factors would hamper eye-hand coordination. My hypothesis: If distracting stimuli (light, sound, and temperature) were in effect, then the scores determined by an eye-hand coordination test would be lower than if these distractions were not present during a test. The procedural design involved a total of eight different environments each with a different combination of temperature, sound, and light stimuli. Five people were tested in each environment. Students were randomly selected to include twenty males and twenty females. Volunteers were asked to play a video game in a small room with various environments in effect. Students were randomly assigned and tested in one of eight environments. Each student played the video game three times. A standard computer program used to analyze a three-factor between member analysis of variance was implemented to analyze raw data. The analysis suggested that only temperature had an effect on eye-hand coordination. Procedural errors might have been lessened by using a larger sample of subjects and/or attempting to better control such factors as skill and alertness of test subjects.

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THE FOURTH R: RHYTHM?

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This is the second year of this project. This year the procedure was expanded to include a control group to attempt to determine if music was the factor which had the positive effect upon performance or if specific types of music would have a positive effect upon a student's performance in the areas of remembering, reading, and arithmetic. Students in grades four and five were the subjects of this procedure. Each student again completed a survey regarding information on; sex, handedness, music lessons, band participation, if the student listened to music while they studied and which type. This information was again used to form groups for the analysis of data. Analysis of data indicated that Baroque music provided the the highest productivity and accuracy of the three types of music used. Rock music provided the next highest level of productivity and accuracy in the area of arithmetic when compared to Baroque. In the project area of reading and remembering, 4/4 music produced the best results regarding accuracy. This was followed by 3/4 music in remembering and control group in reading. Based upon my research, I concluded that music did have a positive/negative effect upon students' academic performance in the areas tested by my project; and that certain types of music produced a more positive effect than others for specific skill areas.
Following the collection of data from this year's subjects, a statistical analysis of both years' data was completed. The purpose of the analysis was to determine if any of the variables would be seen to have significance statistically in their interrelationships.

THE EFFECTS OF TRIMETHYLTIN [TMT] ON MAZE PERFORMANCE IN RATTUS NORVEGICUS (RATS)

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Trimethyltin [TMT] is an organic tin compound that causes neurotoxicity to the hippocampus region of the limbic system. The purpose of this experiment was to show the behavioral effects of TMT poisoning through 1. hyperactivity, 2. perseveration (re-tracing movements) 3. deficiency in learning ability, and 4. memory loss.

Nine female TMT rats and nine female control rats were administered 7 mg. of TMT per kg. of body weight and returned to their cages for 7 days, one rat per cage. All rats were deprived of food one day before testing. Nine TMT rats and nine control rats were tested in 15-minute sessions for three consecutive days in a computer-operated maze. Maze performance was recorded on data sheets listing: total number arm entries per session, number of entries per trial, arm numbers entered, and countdown of 900 seconds per session. Each trial within a session ended when the rat took food from the goal arm.

TMT rats showed the following patterns: 1. one rat showed the effects of "tail mutilation". 2. During maze runs TMT rats stayed in upper and lower right arms of the maze averaging 250 seconds per rat while control rats stayed in upper and lower left arms of the maze averaging 326 seconds per rat. 3. TMT rats ran frequently in straits while control rats made more turns. 4. TMT rats showed increasing activity averaging 162.5 arm entries while control rats made fewer trips to goal arm but took food more frequently, averaging 112.0 arm entries.

While control rats showed typical behavior of exploration followed by trips for food only, TMT rats showed the effects of TMT poisoning through 1. hyperactivity, 2. perseveration, 3. deficiency in learning, and 4. memory loss.

LEFT/RIGHT BRAIN - IS THERE A DIFFERENCE? A TWO YEAR STUDY

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Will a brain hemisphere preference be shown through use of a written test and be observed in physical postures and actions? If so, will there be a correlation between the two and within the physical activities? How will results of testings vary between age groups, i.e. kindergarten, high school students, adults?

I expected to find varying degrees of hemisphere dominance among the different subjects and that younger children might have less definite hemisphere dominance in some areas. I expected that adults might chose professions related to preferences shown on the written test.

I administered over 250 tests to determine right or left brain preference. Written tests included questions dealing with emotions, feelings, preferences, etc. Observations were made of individuals as they performed various physical activities and notations were made of left or right brain dominance.

The physical results indicated definite correlation of hemisphere preference for most subjects in the areas of eye dominance, handedness, hand posture, winking, kicking/stopping a ball, crossing ankles/legs, walking/foot. I found when comparing written tests to physical activities, most of the tenth graders showed a different preference for each, indicating a usage of both hemispheres. Outcomes of paper tests of adults were compared with chosen vocations with results indicating that hemisphere dominance related to type of professions chosen.

These findings led me to realize that an understanding of the brain functions and awareness of hemisphere dominance can be of use personally, in teaching, the business world, science, the armed services, etc.

DOES MUSIC AFFECT SCORES ON SIMPLE MATH TESTS?

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Mom yelled "turn off the radio while doing homework" and so the purpose of this project became to find out if music has an affect on how well students do simple math problems. My immediate hypothesis was that yes music would help students solve math problems. In research I had found that music calms the nerves, reduces fatigue due to work strain, and lessens work monotony. Thus, music helps develop a more efficient climate in which concentration on work increases, errors are reduced, and students are better able to enjoy their school setting. So, does music affect scores on simple math tests?

Testing was done by having four elementary classes do addition and subtraction problems while listening to music; then, 48 hours later, they did the same problems again, rearranged but without music. The other four elementary classes I tested did the test without music first; the second time they did the same problems, rearranged, with the music. The students had three minutes to take the test. I then did statistical work with the test scores which included average, mean, standard deviation, and t-value. I graphed the data results. My graphs and t-values showed that there was no significant difference between math tests taken with music and math tests taken without music. In conclusion, I found that music does not cause a significant difference in math test results; However if I were to do another test, I would use music without words as they seemed to be distracting.

BIOCHEMISTRY

DEVELOPING AN ORAL VACCINE FOR BACILLUS ANTHRACIS — a four year study

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Problem: This is a continuation of a four-year study of Bacillus anthracis, the bacterium that causes the disease anthrax. This segment of the study focuses on developing an oral vaccine for anthrax. No experimentation has yet been done in this field pertaining to an oral vaccine. Therefore, it is necessary to 1) determine if it would be possible to devise such a vaccine and 2) outline a test procedure before progressing with the actual experimentation. Hypothesis: Bacillus anthracis is generally resistant to environmental conditions. Based on this information, the hypothesis states that an effective oral vaccine for anthrax can be devised from existing strains of this bacteria. This can be tested through the inoculation of laboratory animals and the quantitative comparison of the oral vaccine with a known spore vaccine. Method/Materials: Test Organisms—Sterne's anthrax vaccine, B.anthracis culture, tryptose broth; Experimental animals—Swiss albino mice; Source—Texas Veterinary Diagnostic Laboratory, College Station, TX; Cages, Bedding Feed, Water, Test tubes, Syringes, Pipettes, Disposable loops, Tryptose agar plates. This portion of vaccine challenge was performed for me by the biomedical scientist to demonstrate the efficacy of the vaccine. Results/Conclusions: The vaccines were administered as follows: Group I given Sterne's vaccine intraperitoneal, Group II given Sterne's vaccine orally, Group III given the grown culture orally, and Group IV given the control broth. An inoculation period of two weeks passed then the vaccine was challenged with a virulent strain of B. anthracis. There was no continuity in the effect of the challenge dose on the mice. First of all, the death reaction was delayed; then mice from each group died at sporadic intervals. The time-to-death method showed that the challenge dose was not effective when tested; it was found to be contaminated. The oral vaccine devised was demonstrated to be an effective vaccine against B. anthracis infection.

THE EFFECTS OF SECOND MESSENGERS ON ONION ROOT MITOSIS

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This study was designed to determine the effects of two cyclic nucleotides and two phosphoinositides, all known to act as second messengers in biological systems, on growth and mitosis in onion root tips. The nucleotides tested included exogenous cAMP, endogenous cAMP induced by the presence of caffeine or 3-isobutyl-1-methylxanthine (IBMX), di butryl cAMP which is a cAMP analog known to pass through cell membranes, and cGMP. The phosphoinositides tested were phosphatidylinositol 4,5-diphosphate and one of its derivatives, inositol trisphosphate.

Onions were grown for 48 hours in 1, 2, 3, 4, and 5 millimolar concentrations of cAMP, di butryl cAMP, and cGMP. Identical concentrations were used for the studies involving caffeine and IBMX which are known inhibitors of the cyclic nucleotides' degradative enzymes, phosphodiesterases. Since studies of the phosphoinositides indicate they are present in very low concentrations in organisms, onions were grown for 48 hours in 5, 10, 20, and 30 micromolar concentrations of these molecules. To control the effects caused by pH differences, all concentrations were mixed using a 10 mM tris buffer. Controls were grown in distilled water and in 10 mM tris buffer.

After the growth period the roots were removed from the plants and the longest root of each was measured. Two mitotic squashes were prepared from each experimental onion. The number of cells in mitosis and the number of cells exhibiting interphase were compared. Results indicate that both endogenous and exogenous cAMP inhibit mitosis while cGMP and both phosphoinositides are mitotic enhancers.

*Fourth Award - ISEF/Biochemistry

Enzymatic Hydrolysis. A Two YearStudy of Ethanol Production

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The purpose of this project is to look at how enzymes work on grain starches and cellulose materials and what effects the process so that you will be able to maximize your resources. The enzymes brake down the starch and cellulose into fermentable sugars, that are used in the ethanol industry. The second part of this project is to ferment the sugars into alcohol using to kinds of yeast, to compare the amounts of alcohol produced. The third part of this project deals with the distillation of the fermented feedstocks. The objective is to make a way of producing cheap, and high quality ethanol with the least amount of inputs. The fourth part of this project is to look at the exhaust emissions given of by a engine that is run on different percents of ethanol. I have also looked into the effects ethanol has on your cars engine to see if it is a alterative to oil based fuels.

To test these ideas I used many different kinds of tests and procedures therefore I will not list them here. What I found from the testing was that time, temperature, and pH effect the activity of the enzymes greatly. I also found that the fermentation process is greatly effect by the kind of yeasts used. Distillation is a process that is difficult to master, but I have built a distillation device that has a average proof of 189. This is very high compared to the average of 160 proof. In testing the air quality I found that using ethanol at the 10% level will reduce the amount of carbon monoxide given of by 10 to 30%. Ethanol does not effect your car and it is ok'd by all car manufactures.

Ethanol is a safe and good fuel, and it is the only liquid fuel that we have besides gasoline. So I feel we as americans should use more of this fuel.

Biochemical Determination of Bone Disease III

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Osteoporosis is a harsh bone disease that affects 20 million Americans. Currently, testing for the disease is limited to methods called densitometry, which use an x-ray type technique to measure bone density. The test is fairly accurate, but cannot predict or monitor therapy to the disease. A few biochemicals which are present in serum and urine have properties which would indicate a relationship to bone metabolism. Two of these chemicals are currently being studied, they are osteocalcin and its characteristic amino acid, carboxyglutamic acid(GLA).

This project is the third phase of a study relating biochemicals to bone density linearly in order to find a correlation to increased fracture risk. Last year, I studied 19 women subjects and found a good correlation between urinary GLA and bone density.

This year, I am adding a new biochemical to my study- osteocalcin. It is the second most common bone matrix protein and it is now measurable in serum by a commercially prepared Radioimmunoassay kit. My objectives are 1.) to compare GLA to osteocalcin to observe their relationship, 2.) to determine the relationship between osteocalcin and bone density, 3.) to study the affects of fluoride supplementation on the osteocalcin-GLA-density relationship.

For my investigation, I used blood and urine samples taken from a bedrest study that my scientific advisor collected. Fifty-percent of the sixteen subjects were given fluoride supplements. I assayed the urine samples for GLA by High Pressure Liquid Chromatography, and the serum samples for osteocalcin by radioimmunoassay. I found that: 1.) osteocalcin correlated well with bone density in all subjects, 2.) osteocalcin and GLA have a direct relationship that is modified by fluoride.

*First Award - ISEF/Biochemistry

DETERMINATION OF AMINO ACID COMPOSITION OF PROTEINS IN SELECTED LEGUMES

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The rumor persists that a bean is a bean and that meat provides the best source or proteins. For this reason my research study involved a quantitative and qualitative determination of amino acids (a.a.) composition of proteins in selected legumes. This was carried out by performing acid hydrolysis on the proteins while autoclaving them for five hours. Next, barium hydroxide was used to neutralize the acid and the solids were then filtered out by filtration. In preparation for the chromatography a solvent mixture for the quantitative and qualitative chromatography was prepared using separatory funnels. I then ran the qualitative chromatography on a.a standards and on the proteins. The a.a.'s were used to determine which ones were present in the proteins. This process was repeated 3 times to verify my first data. Next. I performed ninhydrin and biuret assays on the proteins. Then the presence of each a.a. was determined by using R_f values. Then the quantitative part was performed by using a different solvent and turning the chromatogram at an 90° angle. I then measured how much of the a.a.'s were present.

In conclusion, I can state that all legumes are not alike, but in fact contain different types and amounts of a.a.'s and that some, such as soybeans have almost all 21 amino acids

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A STUDY OF THE ENZYME B-GLUCURONIDASE IN SENCAR AND SSIN MICE

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Evidence supports that a significantly high level of the enzyme, B-glucuronidase, is indicative of a higher susceptibility to carcinogenesis (Walaszek et al, 1986). Publications also support the theory that a diet supplemented with calcium D-glucarate (compound found in green vegetables) reduces the level of B-glucuronidase, and, in turn, the level of susceptibility to chemical carcinogenesis (Walaszek et al, 1986).

The Sencar mouse strain was bred specifically for sensitivity to carcinogenesis and is therefore 10-20 times more sensitive than other mice (Slaga, 1982). A new strain of Sencar, registered as SSIN, or Super-Sencar, has recently shown tumor incidence 3-fold higher than that of its parent stock (Fischer et al, 1987).

The purpose of this project was to determine if the SSIN mouse displayed a higher level of B-glucuronidase than its outbred parent stock, Sencar. Determinative tests were conducted on organ serum taken from Sencar and SSIN on a calcium supplemented diet, and SSIN on a special calcium D-glucarate diet. It was determined that the SSIN mice on the regular diet appeared to have significantly higher levels of serum B-glucuronidase than the Sencar mouse on the same diet. Also, the special calcium D-glucarate diet was shown to reduce the B-glucuronidase level in the SSIN mice sustained on it. These results indicate conclusively the possibility that a dietary supplement of calcium glucarate (a natural compound) could reduce the chances of humans contracting cancer.

THE EFFECTS OF ADRENERGIC AGENTS ON T-CELL PROLIFERATION

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This paper concerns the Effects of Adrenergics on T-cell Proliferation. In this paper, many of the effects of adrenergic agents on the function of T-cells to proliferate will be discussed. Two of these agents are Propanalol and epinephrine. Through the research, it is hoped that a link between some adrenergics and diseases that effects the immune system will be found.

An invitro model of the T-cell proliferation process will be used. In using human blood, T-cells will be trapped to see them in the experiments. Adrenergic agents will be added in order to see the effects they have on T-cell proliferation.

In tests done to date, there was a drastic inhibition of T-cell formation, when in the presence of epinephrine. This may lead researchers to conclude that epinephrine (adrenlin) may have some part in the formation of pathgens.

EFFECT OF VANADIUM TREATMENT ON MACROPHAGE ATTACHMENT AND NITROBLUE TETRAZOLIUM REDUCTION

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Female B.C.F. mice were subjected to intraperitoneal injections of ammonium metavanadate (NH_4VO_3) every three days for six weeks. The mice received doses of 2.5 or 10 mg V/kg body weight of the vandium compound. Measurements were made concerning the effect of vanadium on the attachability and capability of macrophages to produce the toxic oxygen metabolite, superoxide anion. The measurements showed that vanadium treatment of the host had little effect on attachibilty, but resulted in a dose-dependent decrease in superoxide anion production in the peritoneal macrophages. The yield of cells from the animals treated with the highest dose of metavandate was consistantly lower than from all the other treatments. The yield from animals treated with the lower dose of metal showed increased populations compared with the controls. The percentage of NBT-positive cells from the mice that received 2.5 mg V/kg was significantly lower than that from the control mice. The percentage of of positive cells from the mice that received the 10 mg V/kg treatment was significantly lower than that from all other treatments. Vanadium appeared to have a slight effect upon the basic macrophage function of attachability to glass surfaces, but was very deletorious toward the producton of superoxide anion for killing in the cellular phagolysosome.

THE EFFECTS OF CALCIUM ENTRY BLOCKERS ON HUMAN ERYTHROCYTE CATION METABOLISM

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Hypertension is a heterogeneous disease. Vasoconstriction occurs when intracellular calcium is increased. To recover from this contraction, calcium must be pumped out of the cell. This occurs via Ca-ATPase. Another mechanism for efflux is Na/Ca exchange. As sodium influxes, calcium leaves the cell. Calcium entry blockers (diltiazem, nifedipine) are one treatment of hypertension that my assist in vasodilation. Whether these drugs reduce intracellular calcium by preventing the movement of calcium, inducing the Ca-ATPase pumps or by some other mechanism is still in question. Through this study, using erythrocytes, we are trying to further elucidate this mechanism. The erythrocytes were prepared through procedural steps involving washing and centrifuging the blood. Assays were run to determine the ATPase activity. Results suggested an increase in Ca-ATPase, and no change in Na/K-ATPase. In conclusion, both diltiazem and nifedipine, two distinctly different types of calcium entry blockers, caused an activation of Ca-ATPase activity. Because this pump is, in part, responsible for extrusion of calcium from the cell, this may represent an additional means of reducing intracellular calcium. Neither calcium entry blockers exerted any significant effect on membrane Na/K-ATPase. Thus, calcium entry blockers are unlikely to have their action augmented by stimulation of Na/Ca exchange.

HOW DOES THE COMPOSITION OF FATTY ACIDS OF THE CELLULAR MEMBRANES* OF MUS MUSCULU'S HEPATIC TISSUE IS AFFECTED BY ALPHA-TOCOPHEROL AND ASCORBIC ACID?

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Biological membranes as biochemical systems necessary in the cell, need favorable conditions for better stability. In view of this, research was performed on the influence of ascorbic acid and alpha-tocopherol as antioxidants that could prevent the oxidation of polyunsaturated fatty acids of the lipids from reaching disagreeable levels that are harmful for the cell. The tissue selected for the study was the liver of white mice which received controlled doses of these vitamins. Once the tissue is prepared, the lipids were separated from other substances and sterificated fatty acids were removed from these by mean of Thin Layer Chromatography (TLC) in silica plaques for the analysis of Gas Liquid Chromatography. In addition, fatty acids were extracted from two specific phospholipids: phosphatidyl choline and phosphatidyl ethanolamine, which are found in larger amounts in external membranes, to observe the influence of these vitamins in possible changes to occur in the composition of these lipids. Results suggest a possible inhibition of oxidation in polyunsaturated fatty acids in the tissue which received alpha-tocopherol, but more significant values are required. On the other hand, a function of ascorbic acid as synergist was unnoticeable because the effectiveness of alpha-tocopherol was not increased. It is possible that various cellular factors and biochemical processes have interfered with the reactions involved in the vitamin functions. Therefore, further research is suggest considering such factors.

EFFECT OF CHEMICAL PRESERVATIVES ON THE ANTHOCYANIN CONTENT OF GLADIOLI

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OBJECTIVE: To determine if solutions of chemical preservatives will maintain the pigmentation of two gladioli cultivars (Oscar and Royal Purple). The pigments will be separated by paper chromatography and measured spectrophotometrically to determine the amount.
METHODS: I put five stems of each of Oscar and Royal Purple gladioli in the following solutions: control, sugar, aspirin, clorox, Floralife, soft drink, sodium benzoate, hard water, and soft water. At the end of each day I froze all the petals from that stem. I did this to all the flowers for five continuous days. Three grams of frozen petal were dissolved in an acidified solution. The pigment was spotted on chromatography paper and the R_f values calculated. The irregular spot was cut out and redissolved in 1% acidified solution. A spectrophotometer was used to determine the absorbance of the eluded and direct pigment.
RESULTS: Overall averages of the direct pigment absorbances were:

	Oscar	Royal Purple		Oscar	Royal Purple
Control	.299	.292	Soft drink	.260	.397
Sugar	.304	.256	Sodium benzoate	.228	.014
Aspirin	.335	.264	Hard water	.259	.249
Clorox	.381	.244	Soft water	.348	.292
Floralife	.265	.245			

CONCLUSION: Floralife, sodium benzoate, and hard water decreased the anthocyanin content in the Oscar and Royal Purple gladioli. Sugar, aspirin, clorox, and soft water increased the pigment in the Oscar cultivar. Soft drink (diet lemon-lime) increased the pigment of the Royal Purple cultivar.

*Fourth Award - ISEF/Biochemistry

DIVERSITY OF THE CLASS II ALPHA CHAINS IN WILD AND INBRED MICE

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Class II molecules expressed on the surface of macrophages and B cells are responsible for the recognition and presentation of antigens. The more polymorphic the class II molecules are, the wider range and greater number of antigens they can present to T lymphocytes. Previous studies of the two class II molecules, I-A and I-E, have indicated that the alpha chain of the A molecule is polymorphic, whereas the alpha chain of the E molecule is conserved. This experiment was designed to see if the trend continues in haplotypes derived from wild mice, which offer a wider scope of the natural gene pool. Chromatin isolated from pre-established cell lines of twenty commonly-used laboratory strains and twenty wild mice from around the world were cut with four restriction endonucleases and Southern Blotted on nylon membranes. The A alpha gene in the I-Region of the chromosome 17 was hybridized with a 1.2kb 32P labeled probe. The nearby E alpha region was hybridized with a 6.5kb probe. F values calculated from the autorads indicate that the mean wild A alpha F value is significantly lower than the mean wild E alpha F value at a p value of less then 0.025. Likewise, the wild A alpha locus has a higher number alleles (10) than the wild E alpha locus (5). These results mirrored the data obtained from the inbred autorads. Since more diversity in the class II molecules promotes ability to recognize a larger range of antigens, these results combined with the fact that several strains of mice do not express an E molecule indicate that the E molecule may play a lesser or slightly different role in the immune system than the A molecule. Further research into why the A alpha gene is prone to recombinate while the E alpha gene has been allowed to stagnate may lead to a better understanding of the evolutionary processes involved.

*Second Award - ISEF/Biochemistry

EFFECT OF STORAGE ON VITAMIN B12

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12

INTRODUCTION: Today's society is more concerned with nutrition than in any other period of time. This influenced my decision to test for vitamin B12 in liver.

PURPOSE: The purpose of this experiment is to determine the effects of freezing and chilling on the content of vitamin B12.

MATERIALS: Euglena granulata, liver, agar, distilled water, hot plate, stirrer, beaker, test tubes, stirring rod, oven, grinder, eye droppers, cotton balls (swabs), haemocytometer, slides, microscope, alcohol, pipettes.

METHOD: -liver was collected in intervals and stored for specified periods of time -a medium of agar and water was used -E. granulata was placed in each test tube -liver was cooked -ground liver was placed in test tubes -the test tubes were stoppered -two trials were grown for 7 days and 14 days -a haemocytometer was used to count the number of E. granulata -a ratio of this count was used to compare the amounts of vitamin B12

RESULTS: Fresh liver contained the most amount of E. granulata. A significant decrease occurred in the amount of E. granulata following this.

CONCLUSION: The results proved that the maximum available benefits from vitamin B12 in liver peaked when the liver was fresh and decreased as the storage time increased. On trial #2 grown 1 week the test tube containing liver stored 21 days had a high amount of E. granulata. A possible reason for this could be that bacteria entered the test tubes causing the level of B12 to rise.

MOUSE SMALL CIRCULAR DNAS CHANGE DURING AGING AND DEVELOPMENT IN A TISSUE SPECIFIC MANNER

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I have isolated extrachromosomal circular DNA (eccDNA) molecules from 1-, 8-, 16-, and 24-month mouse brain, heart, and liver tissues. Electron microscopy showed that eccDNAs have slightly larger circles in the 24-month heart eccDNA preparations. There appeared to be no age-related changes in the quantity of these circular molecules in vivo. To determine if there were any age-related changes, the quantity of repetitive sequences in eccDNAs were estimated by probes from the mouse genome (B1, B2, IAP, MIF, and SAT). The hybridization results showed that in heart, B2 sequences were the highest. In liver and brain, SAT sequences were the highest. The quantitiy of B1, B2, IAP, and MIF eccDNAs in heart appeared to decrease at 24-months. In brain and liver the quantity of the repetitive sequences decreased from 1-month to 8-months, at which point a plateau was reached. SAT sequences varied simialrly in all 3 tissues.

8-month old mice were injected with triiodothyronine. At various times after injection, eccDNAs were isolated from brain, heart, and kidney tissues from control and experimental groups. The eccDNA samples were probed with a mixture of B1, B2, IAP, MIF, and SAT sequences. When compared to control values, treated brain and heart tissues showed no significant change in the content of repetitive sequences of eccDNAs. In kidney, an increase in repetitive sequences in eccDNAs peaked at 48 hours and at 72 hours values were back to the control level. These data suggest that the repetitive sequences in eccDNAs change rapidly in response to thyroid hormone treatment.

*Third Award - ISEF/Biochemistry

CONTROLLING ORAL LACTOBACILLUS COLONIZATION: A TWO YEAR STUDY

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The problems of dental disease are of tremendous proportions. Prevention of dental decay depends upon continuing research and the development of better ways to prevent and control the problem. The human mouth teems with a variety of bacteria. A healthy tooth is home to some 150 million bacteria. Trouble begins when the disease causing varieties get out of control. Lactobacillus, a strain of bacteria that is associated with a high rate of decay produce an acid that eats away at the tooth enamel. When the acidity of the mouth is changed in some way, and the pH level is too low, harmful bacteria begin their process of decay. My research presented two problems; 1) would successive rinsings of varied concentrations of $NaHCO_3$ and H_2O mechanically reduce the number of lactobacillus colonies, thus showing up in the saliva, and 2) would rinsing with the concentrations chemically raise the pH level of the mouth saliva causing it to be less acidic, thus less condusive to bacteria formation. A direct attempt was made to show that there was a correlation between the higher concentrations of $NaHCO_3$ and H_2O and more lactobacillus colonies that were removed and the raising of the pH levels. Saliva, with the $NaHCO_3$ concentrations were collected, plated, and incubated for a given amount of time. The results were measured by counting the total number of colonies per CM^2. In conclusion, based on the graphs of these results, a relationship should be apparent that the amount of lactobacillus bacteria in the saliva is dependent on the number of rinsings of the $NaHCO_3$ solutions.

A STUDY OF THE RELATIONSHIPS EXISTING AMONG THE PRIMARY SEQUENCES OF BIOLOGICALLY ACTIVE SHORT-CHAIN PEPTIDES.

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Several studies have been done to find the structural similarities between peptide analogues and even between compounds simply exhibiting similar functions (i.e., vasopressin and oxytocin). However, no studies were found that had attempted to find a relationship among the majority of known short-chain biologically active peptides as a whole. This study will attempt to do just that.
A sampling of twenty-seven peptides (along with their sequences) was aquired from various literature searches on the basis of their ability to fulfill the following requirements: 1) they must possess biological activity, and 2) they must be no more than twenty-five amino acids in length. The primary sequences of those peptides were then searched for patterns using a computer word processor search function.
The results of this study indicated that there are several structural relationships between peptides of very different biological activities. In addition, the majority of N-terminals were comprised of pyroglutamic acid, while the major C-terminal was methionine. Using this data a theoretical pentapeptide was designed which was proposed to possess biological activity. The theoretical pentapeptide proposed consisted of the amino acid sequence: PYG-PHE-GLY-LEU-MET.

***Second Award - ISEF/Biochemistry**

WHAT IS THE DIFFERENCE IN THE AMOUNT OF GLYCEROL IN WINES?

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The purpose of my project is to determine the amount of glycerol between sweet and dry wine and show the significance of the fermentation process in the production of glycerol. To determine the amount of glycerol in the wines, I used the potassium dichromate oxidation method as outlined in David Pearsons book, The Chemical Analysis of Foods. My hypothesis states that the amount of glycerol can be found by using the amount of alcohol as an indicator. The main indicator is the relative dryness of the wine. The dryer the wine the more alcohol, and, therefore, the more glycerol.

My hypothesis was based on research conducted at four libraries around the Los Angeles basin. The reason for the difference in the amount of glycerol is that as a wine is fermented longer it is allowed to produce more glycerol. Therefore, dry wines, which are fermented longer, have more glycerol than sweet wines that are not allowed to ferment as long as the dry wines.

Some improvements that can be made include experimenting with other wines and repeating the experiments. Limitations in the procedure will be adjusted as well as trying other methods to determine the amount of glycerol in wine.

COMPARATIVE ELECTROPHORESIS OF MONILETHRITIC HAIR: PHASE TWO. Gunter, Chris, Shamrock HS, Decatur, GA 30033. 1625 Sprucewood Ct., Decatur, GA 30033

Monilethrix is a rare hereditary disorder and an autosomal dominant trait. It differs from normal hair in that it causes repeated nodes and internodes along the individual hair shaft, and the hair will fracture near the roots in one of the fragile internodal portions.

By separating molecules according to size, charge, and pH, electrophoresis has repeatedly proven to be a viable differentiation method for proteins. Several different forms of electrophoresis exist and can be used with a variety of media. However, electrophoresis is reserved mainly for serum or other non-fibrous proteins.

Electrophoresis was utilized in an attempt to seek any differences in the proteins of normal and monilethritic (or affected) hair. Hair samples from ten subjects related to the affected researcher were extracted and analyzed through one- and two-dimensional electrophoresis and isoelectric focusing. All of the gels were examined by naked-eye or computer imaging systems.

The last one-dimensional run showed a light band only on the affected samples, while the two-dimensional gels also evidenced large proteins visible only on the affected and not on the normal hair. Future work on the procedure could lead to isolation of the aberrant proteins in monilethrix while also perfecting electrophoresis for forensic and even diagnostic purposes.

*Fourth Award - American Chemical Society

BIRTH CONTROL FOR YOUR PLANT? PHASES II, III, & IV.
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The purpose of this project was to further examine the results of Phase I: the effects of human hormones (birth control pills) as growth stimulators in plants. Three separate phases budded from research of fertilizers and hormones and from the results of Phase I. They are Phase II, testing hormone solution against water and fertilizer on a variety of plants, Phase III, testing a new solution of hormones plus fertilizer against the previous solutions of Phase II, and Phase IV, testing hormone solution against water on germination speed.

Based on last year's results, it was believed that all hormone solutions would work to accelerate growth and speed up germination time.

Phase II consisted of twelve broccoli plants and nine lettuce plants all divided equally into groups A, water, B, birth control pills dissolved in water, and C, Peter's Professional 20/20/20 fertilizer in water. All plants were watered approximately every three days, and their heights were measured and charted every two weeks. Phase III consisted of sixteen cabbage plants divided equally into four groups, three of which were watered with the above solutions. The fourth was watered with a solution of hormones and fertilizer. These plants were watered and charted the same as Phase II. Phase IV consisted of two groups of innumerable cabbage seeds divided into groups A and B. Group B was soaked in the hormone solution then both groups were planted, watered, and checked everyday for signs of germination.

In Phase II, the Group B broccoli and lettuce exceeded Groups A and C with height and overall appearance. In Phase III, the Group D cabbage plants displayed a greater amount of growth over a month than the other three groups. In Phase IV, the Group B seeds germinated four days earlier than Group A and also four days earlier than normal germination time.

The hormones in the birth control pills proved to act as growth accelerators and plant hormone substitutes in all three project phases.

THE INHIBITION OF MNEMONIC ABILITY DUE TO AN ALUMINUM COMPOUND

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Memory is a phenomena which takes place in most living complex organisms. Gaffan (1972) assumed two types of memory: association and recognition. Recognition memory implies information about the novelty of a stimulus or a response. This proposal by Gaffan corresponds to the contextual retrieval theory which states that the retrieval of one item of stored information is initiated by a cue which refers to the retrieval information. Basically, this is the foundation of my project. However, the object was to determine if an aluminum compound (aluminum oxide) would inhibit these mnemonic abilities using a Pavlov conditioning techniques on Dugesia tigrina.

The Pavlov conditioning techniques consisted of turning on a flashlight (visual stimulus) for 1 sec. After that time had elapsed the organisms were physically shocked with an electric current for two seconds. After that time had elapsed the visual and physical stimulus were removed. During the treatments two specific pieces of data were obtained: the total percentage of response per test group, and the degree of cringing movement caused by the stimuli. My results illustrated that the greater the concentration the lower the percentage of response and also the lower degree of cringing. Therefore, it can be concluded that the aluminum oxide does inhibit mnemonic ability in Dugesia tigrina.

This experiment may be corresponded to Alzheimer's Disease, an organic brain dysfunction in which neurofibrillary tangles and plaques (containing excess amounts of aluminum) form around the hippocampus disconnecting input and output information passageways. In relation this may inhibit contextual retrieval.

*Fourth Award - ISEF/Biochemistry

BIOCONVERSION OF ORGANIC WASTE* FOR ENVIRONMENTAL ATTENUATION AND FOR THE RECOVERY OF RESOURCES

*(Tuna Industry Waste)

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Complex-organics water pollution, one of the results of modern man's increased manufacturing activities, has traditionally been attenuated thru aerobic and/or chemical treatment. Anaerobic treatment (known for over 80 years), have the distinct advantage of allowing:

- The possibility of recovering resources:
  - An energy rich gas
  - A nutrients- rich liquid effluent
  - A biochemically stable semi-solid sludge, with a useful vegetable nutrient content
- A reduction of up to 90% in the content of solids.
- The decomposition of very difficult substrates (ranging from complex hydrocarbons to organic solvents).
- The use of metabolic manipulation for degradation of toxic substances (cyanides,sulphates...)

The anaerobic process experiment herein submitted for evaluation,is intended to demonstrate the (first three) referred resources- recovery capabilities of this technology, processing tuna- fish canning industry waste.

The procedure involved inoculation of the substrate with a Ruminantia-sourced culture under anaerobic conditions. Intermitent loading of the anoxic reactor and effluent discharge were achieved by maintaining reactants within vessel's liquid-phase seals. Generated biogas was accumulated in water-sealed vessels.

Theoretical medium-heat quality of obtained biogas was demonstrasted by short-term sustenance of combustion. Nutrient quality of the supernatant was demonstrated by visible weight gain in a *Poecilia Reticulata* culture. NPK- content quality of the sludges was demonstrated by appreciable *Phaseolus Vulgaris* growth and development.

Conclusion:

The use of tuna industrial waste as a viable substrate for anaerobic degradation and resources recovery, merits exploration beyond the laboratory scale.

THE EFFECT OF BIRDSFOOT TREFOIL ROOT EXUDATE ON RHIZOBIUM LOTI GROWTH

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The problem was to determine if chemotactic bacteria have a competitive advantage over those that are motile only in the nodulation of a plant, and to study the growth stimulating effects of birdsfoot trefoil root exudate on R. Loti.

The hypothesis was that chemotactic bacteria would have a higher rate of nodulation than those that are only motile or non-motile. It was further thought that root exudate would play an important part in specificity, as well as stimulate growth.

Swim tests were used to determine if the bacteria were motile, chemotactic or non-motile. Through centrifugation the root exudate was broken up into different components. Each component was tested for growth stimulating effects on bacteria.

Of the 200 mutants tested, two strains were found motile, one chemotactic, and 20 were non-motile. The root nodule assay still needs to be performed. The root exudate supernate was not significant as the growth stimulate, but 30% pellet was. The reason for growth stimulation by 30% pellet is unknown--it is not the presence of sugar or the amount of protein, because there was no sugar in any samples and protein content was the same in all. Tentatively it is believed that the reason for stimulated growth by 30% pellet is a specific type of protein or another unknown component. It is speculated that protein is not large since boiling the root exudate had no effect on its ability to stimulate growth. I have made no conclusions yet on the swim tests and nodulation, because root nodule assay still needs to be performed.

#Fourth Award - ISEF/Biochemistry

HOW DO ENZYMES WORK? A CASE IN POINT USING THE GALACTOSIDASE FROM *AZOTOBACTER VINELANDII*

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Enzymes are protein molecules which possess catalytic properties and hasten certain chemical reactions. The effectiveness of an enzyme under optimal physical conditions can be described in terms of Vmax and Km. Vmax is the maximum speed at which an enzyme can break down raw material. The higher the Vmax value, the higher the product output. Km, or the equilibrium constant, is half of the concentration of the substrate necessary to reach Vmax. This project involved work with an enzyme termed alpha-Galactosidase, secreted by the soil bacterium *Azotobacter vinelandii*, which breaks down complex carbohydrates into simple sugars for bacterial growth.

Alpha-Galactosidase recognizes a galactose molecule in complex sugars such as melibiose and raffinose(which are common products of plant cells). It also recognizes the galactose molecule of an artificial sugar termed PNPG (p-Nitrophenyl-D-galactopyranoside). When PNPG is hydrolyzed, it turns yellow. The rate of yellow color produced by PNPG measured by a spectrophotometer, represents the hydrolytic rate of the enzyme. When a mixture of PNPG in certain sugars (which can react with the enzyme) is used as substrate, the rate of PNPG hydrolysis decreases. The purpose of this study was to determine the various effects of substrate inhibitions on the hydrolysis of PNPG by the enzyme alpha-Galactosidase.

This controlled experiment dealt with the sugars galactose, glucose, arabinose, melibiose, and raffinose. As a result, it was found that (1) galactose and melibiose compete with PNPG at the binding site of the enzyme and (2) glucose binds to the enzyme and changes the shape of the enzyme, thus reducing its hydrolytic rate.

AN HPLC ANALYSIS OF THE AMINO ACID STRUCTURE SEQUENCE OF SPIDER SILK

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Spider silks are a diverse group of fibers, particularly when discussing their physical properties. These silks vary from those with a tensile strength greater than steel (7.8 vs. 3.4 g/denier) to those with elasticity greater than wool (46% vs. 43% extension to break). In order to take advantage of these properties and to possibly biosynthesize fibers with these unique properties, a two-phase experiment was conducted. Phase One consisted of two separate objectives: (1) The identification of the protein(s) in spider silk, and (2) purification of the silk protein(s). Phase-Two consisted also of two separate objectives: (1) To determine the amino acid composition, and (2) To determine the amino acid structure sequence. The results from Phase-One indicated a valid continuation of the project to Phase-Two. The unique properties of spider silk and the possibility of genetically engineering fibers with specific properties provide this project with the likelihood of greatly expanding the availability of biosynthetically produced materials.

*First Award - U.S. Air Force
First Award - U.S. Navy
Alternate to Scholarship - U.S. Marine Corps

THE EFFECTS OF CALCIUM ON ASCORBIC ACID'S STABILITY

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The purpose of this research was to test the effect of calcium on the stability of ascorbic acid. In this project, 2,6-dichloroindophenol sodium solution, an indicator for vitamin C, was used to determine if there was any significant difference in the amount of vitamin C after the calcium was added as compared to before it was added. The calcium was in the forms of calcium turnings (100% calcium) and calcium tablets ($CaCO_3$).

Ascorbic acid and different brands of orange juice (regular and calcium fortified) were tested. These solutions were titrated into the indicator six different times, and an average was taken.

The results obtained did indicate that there was indeed a lower concentration of vitamin C after the calcium was added to the solution.

EFFECTS OF CAVITY SIZE ON THE INCLUSION COMPLEX FORMATION OF BENZO(A)PYRENE IN CYCLODEXTRINS

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The effect of cavity size on the inclusion complex of Benzo(a)pyrene (BaP) with cyclodextrins (CyD) has been studied by fluorescence, absorption, and induced circular dichroism spectral measurements. It is concluded that Alpha-CyD forms little or no inclusion complex with BaP. Beta-CyD forms a 1:1 inclusion complex, while in Gamma-CyD, the dominant inclusion complex structure is 2:1 with BaP. A comparative study was made on Benzo(e)pyrene and the results showed that BeP does not form any inclusion complex with Alpha-CyD. However, experimental data also confirmed monomer formation in the cavities of Beta-CyD and Gamma-CyD.

*Second Award - ISEF/Biochemistry

IS THE KIDNEY'S RESPONSE TO ACID-BASE BALANCE DEPENDENT UPON THE INTAKE OF NaCl?

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The kidney is responsible for water and electrolyte homeostasis. The composition of body fluids depends not only upon the concentration of electrolytes, but also upon the concentration of acids and alkalies. Acids and alkalies are products of metabolism which are necessary for life. In order for such reactions to proceed normally, the body must maintain a systemic and in particular, intracellular pH within narrow limits. This is called acid-base balance. The purpose of this study was to determine whether the kidney's response to acid-base balance is dependent upon the intake of NaCl.

Eight New Zealand White rabbits were maintained in metabolic cages for nine weeks. The diets used in this study were: NaCl, KCl, $NaHCO_3$ and $KHCO_3$. These were compared to the Basic diet, free of electrolytes, which served as a control. Each diet was administered one week with tap water and one week with saline solution. Weight gained, food and water consumption, and urine excretion were recorded. To determine the status of acid-base balance, blood was collected and analyzed for sodium, potassium, chloride, arterial blood gases, and plasma creatinine. Urine samples were also tested to determine the amount of electrolytes and creatinine in them.

The concentration of electrolytes excreted in the urine was equivalent to the amount of electrolytes consumed by the organism. Sodium chloride by itself did not alter acid-base bicarbonate and pH composition. The plasma acid-base status of the animal depends upon the type of salt added to the diet when the animal was on a sodium chloride deficient diet. The kidney did regulate acid-base composition when there was an ample supply of sodium chloride in the drinking water.

*Third Award - ISEF/Biochemistry

EFFECTS OF DIMETHYL SULFUXIDE (DMSO) IN THE PHASEOLA VULGARIS GENETIC TRANSFERENCE

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The plant Phaseola Vulgaris is a leguminous plant which grows extensively in different parts of the world. The purpose of the project is to determine the possibilities and advantages in which the chemical substance (DMSO) exerts in the improvement of the genetic transfer in plants.

To conduct the experiment, 732 plants were grown and divided into two phases. The first phase was to determine the previous effect of each liquid to be used in the genetic transference. Every group of experimental beans had the same conditions of Control plus DMSO.

In Phase II, the red bean characteristics were transferred to white, pinto, black and pink beans. Some red beans had been treated and others had not. 10 red beans were treated with 50 ml of DMSO and mixed in a blender. This solution was filtered and 0.01 cc of the red bean solution was injected in the main part of the other seeds. The solid part was introduced in the cotyledon near the main part of the seed in another kind of bean. The same procedure was repeated with the other treated and untreated beans.

The results showed that DMSO produced a great genetic change in the color and size of the leaf, in the germination, and in beans with one, three and four cotyledon.

It can be concluded that DMSO can be used in genetic transference because it produces plants with better characteristics to be used as food.

T-LYMPHOCYTE STIMULATION WITH THE PHORBOL ESTERS

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Phorbol ester tumor promoters are known to mimic the effects of diacylglycerol (DAG), the physiological activator of the enzyme protein kinase-C (PKC) in the stimulation process of T-lymphocytes. However, the part of the phorbol ester molecule actually involved in the activation of PKC is still uncertain. It was hyphothesized that the side chain of the phorbol ester molecule is responsible for the activation of PKC because of the chain's great similarity to that of DAG.

Experiments were conducted by using the Ficoll-paque gradient centrifugation method to obtain peripheral blood mononuclear cells (PBMC) from heparinized blood of normal healthy donors. These cells were stimulated prior to incubation at 37° C in 2.5 ml well culture plates for 24 hours. The stimulated cells were then labeled with an anti-IL2-Receptor mAb to be analyzed by flow cytometry for IL2-Receptor expression.

Results indicate that the side chain of the phorbol ester molecule is not directly involved in the activation PKC. However, it is believed that the lipophilic properties of the side chain allow the penetration of the molecule through the membrane to reach the receptor PKC. In addition, the phorbol ester molecule must also possess the crucial biological structure in the phorbol nucleus in order for PKC recognition and activation.

*First Award - American Medical Association
First Award - ISEF/Biochemistry
First Award - U.S. Army

THE EFFECTS OF STORAGE ON RAT ERYTHROCYTES

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The erythrocyte is a tiny, biconcave disk that circulates throughout the peripheral blood supply. The main function of the erythrocyte is to carry oxygen and carbon dioxide. This particular cell was chosen for this study as there is a large distribution of information regarding the red cell and that when damage occurs to the cell membrane, hemoglobin is released. Once the hemoglobin is released, the researcher can pass a wavelength of light through the sample in the spectrophotometer at 540 nanometers to obtain quantitative results.

In the study the question raised pertained to two groups of rats; adult (4-5 mos) and aged (24-25 mos): which animal would retain red cell integrity longer after the blood was stored for 0, 1, 7, 14, and 21 days? The study involved sacrificing the animals and withdrawing blood for storage at 4°C in an Alsevers solution and testing the solutions at 0, 1, 7, 14, and 21 days for hemolysis with saline concentrations ranging from 0.0% to 0.85%.

There were three experiments for the adult and three for the aged, each containing five tests done in triplicate using two rats. Therefore, 6 rats were utilized for this study from each group. The results from the spectrophotometer readings were then converted to the percent hemolysis.

The final results obtained exhibited that there was indeed an observed difference between the adult and the aged rat red cell viscosity and integrity. This was demonstrated graphically by the lines of adult vs. adult where the lines would continually intersect and correlate almost identically.

A CA^{++} CURRENT STIMULATED BY GABA-A BINDING

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In this experiment, I investigated the linkage of gamma-aminobutyric acid (GABA), the major inhibitory neurotransmitter in the vertebrate central nervous system, to calcium transport. Ca^{++} is a divalent cation which is fundamental to neural signalling because of its role as a secondary messenger.

Two specific preparations were compared using PBSS (buffer) + ${}^{45}Ca^{++}$ (control), and GABA + ${}^{45}Ca^{++}$ + PBSS (experimental). Other experimental conditions were included in order to elucidate the role of the GABA-A and GABA-B receptor complex. It is well-established that the GABA-A receptor is sensitive to bicuculline (an antagonist of GABA) and GABA-B is bicuculline-insensitive. Therefore, two additional conditions were included, namely, bicuculline + PBSS, and bicuculline + GABA + PBSS.

All four solutions were introduced separately to intact chick brain cells in primary dissociated cell culture. These solutions were discarded after 15 seconds, and the dishes were immediately washed four times in PBSS. The amount of ${}^{45}Ca^{++}$ was then measured with a scintillation counter.

These data were subjected to an analysis of variance (significant at $p<0.03$). Next, a series of two-tailed t-tests were performed. The GABA results were different from the control ($p<0.01$), different from the bicuculline results ($p<0.01$), but not different from the GABA + bicuculline results ($p<0.07$). These results indicate that GABA's binding to the GABA-A receptor stimulates a Ca^{++} current.

*Third Award - ISEF/Biochemistry
Honorable Mention - American Chemical Society

EFFECTS OF ASPARTAME ON PROTEASE ACTIVITY OF BRINE SHRIMP

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Brine shrimp grown for 5 days in mediums containing aspartame (2.5 and 5.0 mM) resulted in increases in dry weight (16% and 34% respectively) and total protein (15% and 67%) over the control shrimp. Two dimensional thin layer chromatographic analysis showed that the aspartame groups were significantly lower in the level of free amino acids than the control group. These results suggest an effect of aspartame upon the protein metabolism of brine shrimp, which may be due to an increased synthesis and/or a decreased breakdown of proteins. The effect of aspartame on protein breaking down enzymes (proteases) was tested.

A spectrophotometric assay was developed to measure the effect of aspartame on alkaline (pH 9.0), neutral (pH 7.5), and acidic (pH 4.9) proteases of brine shrimp using the substrate sulfanilamide-azocasein. A higher level of substrate digestion occurred at the pH 9 assay incubated at 37°C for 60 min (72.3/µg substrate/hr/mg protein) than at the neutral and acidic pH. The 4.9 pH assay had the lowest amount of digestion of substrate (10.83 µg substrate/hr/mg protein). Aspartame was added to the assays in the concentrations of 0.5, 1, 2, and 3 mM. The pH 4.9 assay with 3 mM aspartame showed a decrease in activity of 13%. The pH 7.5 assay with 3 mM aspartame showed a decrease in activity of 5%. The pH 9 assay with 2 mM aspartame had a decrease in activity of 6%. Thus the effect of aspartame on various proteases is small and may not be responsible for increased protein content. In the future, the second possibility that aspartame increases protein synthesis should be studied.

THE SYNTHESIS OF ORGANIC MOLECULES UNDER SIMULATED PREBIOTIC EARTH ENVIRONMENTS

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The purpose of this project was to synthesize organic molecules from inorganic molecules in an atmosphere similar to that of the prebiotic earth. This was done to state the possibility of such an occurance as the first beginings of life on earth but only according to the normal chemical and physical laws of nature.

A system was constructed to mix the chemicals methane, aqueous amonia, and water. These chemicals are believed to have been very common on the prebiotic earth. An electric spark was sent across the mixture to simulate the intence energy present in the prebiotic atmosphere. This spark provided the energy needed to break down the chemicals and re-form them into other chemicals.

From these experiments, glycine, leucine, and lycine have been identified. These are the three most common amino acids. Other products were formed, but they could not be identified because of the absence of more sophisticated equipment.

#FIBRINOGENS ROLE IN THE WOUND HEALING PROCESS: II. FIBRINOGEN STIMULATES ENDOTHELIAL CELL MIGRATION

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This is the second year study of fibrinogen's role in the wound healing process. The previous year's study showed that the alpha chain, on the fibrinogen molecule, is responsible for the adhesive activity of fibrinogen. It was also found that the RGD amino acid sequence from the alpha chain is responsible for this activity.

This year's study showed positive migration activity from the fibrinogen molecule. The beta and gamma chains are responsible for the chemotactic migration activity of the fibrinogen molecule. A 15 amino acid sequence from the gamma chain was found to be responsible for the activity of the gamma chain.

#First Award - American Medical Association
First Award - American Veterinary Medical Association
Second Award - U.S. Air Force
Fourth Award - ISEF/Biochemistry

SHELF-LIFE STABILITY OF LIPIDS IN CONFECTIONARY SUNFLOWER KERNELS

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North Dakota is number one in the production of sunflower seeds in the nation. It is a main source of cooking oil.

The four main constituents of sunflower oil are palmitic, stearic, oleic, and linoleic acid. Most of these do not occur in free state but are present in triacylglycerides.

The sunflower seeds were ground and the oil extracted using hexane. The oil from hexane was obtained by a rotovaporizer. Methyl ester derivatives were prepared from both rancid and non-rancid oils and total fatty acids. All were analyzed by a Gas Chromatograph (GC). Palmitic, stearic, oleic, and linoleic standards were used to identify the fatty acids from the oil.

The results indicated that the rancid oil had a lower linoleic and oleic acid content in comparison to the fresh oil. Oleic and linoleic acids are unsaturated fatty acids and can be easily oxidized. The rancidity can be prevented or minimized by using antioxidants. The oxidation of sunflower oil is a natural process as the oil ages. This aging, under normal standard conditions, causes the sunflower oil to become rancid.

HEPATIC DRUG METABOLIZING ENZYME ACTIVITY IN FARM AND LAKE-RAISED CATFISH

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This study of the hepatic drug metabolizing enzyme activity in catfish has been prompted by the frequent pollution of aquatic environment and the large consumption of catfish and other fish in the United States. The difference in activity of the hepatic drug metabolizing enzyme system of farm and lake-raised catfish was determined with the assays of cytochrome P-450 and cytochrome P-420 content, aryl hydrocarbon hydroxylase (AHH), aminopyrine N-demethylase, and the microsomal phase II assay, UDP-glucuronyl transferase.

There are two types of hepatic drug metabolizing enzymes. Phase I enzymes are mainly composed of cytochrome P-450 which can detoxify as well as activate xenobiotics. Phase II enzymes are conjugate enzymes which only detoxify xenobiotics. The results of all the assays were found to be significant. A higher cytochrome P-450 activity was found in the lake-raised catfish than in the farm-raised group. The farm-raised livers were found to have a higher AHH activity, aminopyrine N-demethylase, and UDP-glucuronyl transferase than the lake-raised group. Since a higher phase I enzyme activity was found in the assays stated above, there appears to be a greater risk in the activation of carcinogens. However, the increase of the phase I enzymes may be compensated for by the higher activity of the phase II enzymes. This increased activity could be caused by antibiotics sometimes fed to commercially raised fish to fight disease, and the water source of the ponds in which the fish were raised could have been contaminated by chemical or pesticide run-off from the nearby agricultural area. However, it is here no way suggested that lake-raised catfish live in a cleaner environment since samples could not be taken from all the lakes in the area. A chemical free environment which would have served as a control group was not found to be present.

*Fourth Award - ISEF/Biochemistry

EFFECTS OF VARIOUS SUBSTANCES ON LIPID OXIDATION

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This experiment tested the actions of various substances on lipid oxidation. Corn oil was used to represent the lipids in biological membranes. Lipids are exposed to oxygen carried by the blood, but do not become oxidized in the presence of vitamin E, vitamin C, selenium, and beta-carotene. Conversely, pantothenic acid, niacin, and vitamin B-2 assist in the oxidation that occurs during lipid metabolism. RNA/DNA was also tested for its possible oxidant effect on lipid membranes. Various amounts of the above substances were applied to corn oil, which was heated and aerated to simulate actual body conditions. After either a six or twenty-four hour interval, oxidative rancidity was determined with a colorimetric test involving drops of bromine. A later procedure tested the lipid after every thirty minutes in a two hour period with the iodine absorption method using Hanus solution. The overall results displayed the antioxidative effects of vitamin E, vitamin C, selenium, niacin, and vitamin B-2. Pantothenic acid, beta-carotene, and RNA/DNA seemed to encourage lipid oxidation. Research has shown that the free radicals involved in lipid oxidation are also responsible for the spread of disease such as cancer, and therefore a natural follow-up to this project would be to test the resulting antioxidants as anticarcinogens, and the pro-oxidants as carcinogens.

DOES LECITHIN DECREASE THE CHOLESTEROL CONTENT IN EGGS?

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Lecithin, a soybean derivative, is widely used as a natural aid for circulatory problems and increased cholesterol levels.

Coronary heart disease as the number one killer, with other circulatory ailments, accounts for more than 50% of all deaths in the United States today. This is closely associated with atherosclerosis, a disease characterized by cholesterol deposition in the coronary artery.

The egg is a versatile, nutritious food for humans. It is the single most complete food used daily in most households.

The experiment was designed to determine if lecithin could reduce the cholesterol content in eggs.

To investigate this, 12 pullets were divided into 2 groups - 6 experimental and 6 control. The experimental group was fed Purina laying crumbles mash containing lecithin for 6 weeks. The eggs were gathered from both groups in 2-week intervals; washed; weighed on an analytical balance; and the cholesterol level measured using the Lieberman-Burchard method.

In comparison to the control pullets, observations of the experimental pullets were: ate 30%-50% less food, produced 10% more eggs, produced eggs 6.88% lighter in weight, drank more water, lost more feathers, had loose stools, had no weight loss.

The lecithin reduced the level of cholesterol by 9.4% in the experimental group. It appears that lecithin added to the chicken's diet does reduce cholesterol content in the eggs by a measurable amount. Through breeding techniques and change of diet, specifically lecithin supplement, and/or other modifications of habitat, eggs with significantly decreased cholesterol content may be achieved for marketability.

INSERTION OF THE E. COLI B-GALACTOSIDASE GENE INTO XENOPUS LAEVIS

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The insertion and expression of a foreign gene into the genome of an animal was investigated. We wanted to know what percentage of the injected animals were able to incorporate the gene and whether expression of the gene was deleterious to the animal.

Artificially fertilized Xenopus laevis (South African frog) eggs were microinjected with the pCH110 plasmid which contained the SV40 early promoter region fused with Escherichia coli lac Z gene that codes for the enzyme B-galactosidase. Expression was assayed by measuring B-galactosidase activity in whole bodies or tail tissue. The presence of the gene in the frog genome was confirmed by DNA dot blot analysis. Six of the 13 embryos tested positive for pCH110 incorporation while limited expression of B-galactosidase was observed in whole bodies. The mortality rate of the injected group did not differ significantly from the controls, suggesting that expression of B-galactosidase was not toxic to the embryos.

Thus, we concluded that a foreign gene can be successfully incorporated in the frog's genome. However, expression is limited and may be localized in certain tissue.

ALLELOPATHIC CHARACTERISTICS OF *GLECHOMA HEDERACEA*

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The term allelopathy refers to those biochemical interactions which occur between all types of plants and their surrounding environments. Because ground ivy rapidly overtakes plants in lawns and gardens, the purpose of my investigation was to determine the possible allelopathic potential of *Glechoma hederacea* in various controlled surroundings. Three methods by which the ivy could chemically affect the growth of other plants are: the use of volatile compounds released by the leaf tissue; decaying leaves seeping into the soil; or root exudates excreted by the trailing vines. Using test species of radish, clover, and greenred sorghum grass, it was possible to determine the effects of ivy on their germination percentage and growth. The first series of tests in this experiment concerned the effects of volatile ivy compounds on the test species by using a sponge bioassay method and fresh ivy leaves. The second phase of the experiment tested the effects of decaying leaves on the germination and growth of the test plants. A final test determined any possible effects of ivy root exudates on the growth of test seedlings. The evidence gathered through the experimentation indicates that the ground ivy is significantly allelopathic to at least some species of plants. The root exudates, decaying leaves, and volatile compounds of ivy inhibited the growth of clover and grass, while slightly stimulating the growth of radish plants in certain cases. One question which arises from the results of this investigation is which specific chemical produced by *Glechoma hederacea* is responsible for the inhibition and stimulation of the test species of plants. The final phase of this study attempts to classify the biochemicals ivy releases through a chromatographic analysis.

***Third Award - ISEF/Biochemistry**
Honorable Mention - Eastman Kodak Company

*IN VIVO AND IN VITRO STUDIES OF PENTAMIDINE ISETHIONATE AND ITS AFFINITY TO DIABETES MELLITUS: A TWO YEAR STUDY

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The antiprotozoal agent, pentamidine isethionate, has been suspected to produce the adverse reaction of hyperglycemia followed by diabetes mellitus. This research was performed to determine this complication.

ICR mice were treated with placebo and pentamidine in doses equivalent to normal human dosages, for ten days. Blood glucose indicated a normal level in controls, while treatment groups were hyperglycemic, revealing a probability of .001. Islet cells from pancreas of both groups were isolated and treated group proved to have increased granulation under microscopic examination, due to increased insulin storage.

An in vitro procedure was established to determine the response of islet cells to pentamidine, when grown in culture. Cells were isolated, incubated with basal or pentamidine treated media for 24 hours. Islets were then exposed to glucose treated or basal media to determine the cell response to glucose. A radioactive insulin assay was performed to test for free insulin. Results proved a marked decrease in free insulin in drug treated cells. Statistical analysis revealsed a .001 probability.

***First Award - American Medical Association**
Fourth Award - ISEF/Biochemistry

THE ALLEVIATION OF MERCURIC CHLORIDE TOXICITY ON EcoR I BY USE OF EDTA AND ACTIVATED CHARCOAL - SECOND YEAR STUDY

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A restriction endonuclease is a bacteria's natural defense mechanism against viruses. It recognizes specific palindromic sequences within double-stranded DNA and makes double stranded cuts in the DNA at its specific palindrome. Since heavy metals often affect the three-dimensional shape of proteins, resulting in a loss of activity, it is possible that heavy metals affect the function of a restriction endonuclease. The initial stage of experimentation tested this hypothesis by using restriction endonuclease EcoR I on Lambda phage DNA under control conditions to obtain a pattern of cleavage as evidenced by agarose gel electrophoresis. The experiment was then repeated assaying the restriction endonuclease in the presence of cadium chloride, mercuric chloride, ferric chloride, and zinc chloride at 10^{-3} M and in the second stage of my experimentation, lead nitrate at 10^{-3} M. Only mercuric chloride at this concentration and lower concentrations inhibited the enzyme's activity.

Since these data indicated that mercuric chloride alters EcoR I specificity on Lambda phage DNA, it was questioned whether its toxicity could be inhibited using EDTA, a chelating agent, and activated charcoal, a filtering agent. The EDTA at concentrations of 10^{-2} M, 10^{-3} M, and 10^{-4} M was mixed with the mercuric chloride at 10^{-3} M, before adding to the assay mixture. All of these concentrations prevented the mercuric chloride from inhibiting the enzyme. Filtering 10 ml of the mercuric chloride at 10^{-3} M through 1 g of charcoal, 0.5 g of charcoal, and 0.1 g of charcoal also prevented inhibition of the endonuclease. Thus, it appears that these agents could be used to remove mercury from the environment since it is extremely toxic to all forms of life, including man.

EFFECT OF ANTIOXIDANTS ON LIPID OXIDATION IN FROZEN COOKED TURKEY GIBLETS AND BROTH USING TBA TEST

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There is little value in giblet and neck meat in turkeys. These are sold with the whole body bird at 69-89¢ per pound and sold separately at 10-20¢ per pound. The processors are very apprehensive about removing these meats which weigh 1-2 pounds. Thus, they would need to compensate for the weight loss. So they remain.

Value can be increased by removing bone and sinew and adding water to form broth and a thickner to form gravy. The gravy, frozen with the whole body bird, then replaces the weight of bone and sinew previously removed.

The problem is that removing bone and sinew and chopping increase surface area and so increase oxidation.

My objective is to find what antioxidant might be effective in preventing flavor changes during frozen storage and finding a natural antioxidant which is pleasing to the consumer.

I prepared meat and broth samples and added ascorbic acid and alphatochopheral as antioxidants. Using TBA test, in combination with TEP, I measured malonaldehyde concentration in the samples during frozen storage.

I observed that in all tests there was an increase in rancidity. Antioxidants had an effect on the decrease in rancidity, but not to the extent anticipated. Through increase in concentration and possible combinations of the antioxidants, greater reduction in rancidity may be obtained.

*THE INTERACTION OF HISTIDINE WITH THE STARCH BOND

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The addition of histidine to a Starch-Iodide solution in the Amyloclastic Assay was found to alter the conformation of the I-starch complex and induce a loss of the typical blue color of the solution in a manner similar to that of active amylase. It was then theorized that the conventional, clinically applied assay used to diagnose the condition known as acute pancreatitis could no longer be considered a definitively accurate technique for the detection of the enzyme.

Several studies were conducted to determine the precise nature of the phenomena observed. It was found that this phenomena is specific for histidine, and that the reaction was reversible- indicating that bonds were not being broken. This knowledge helped in developing a variation to the amyloclastic assay which entails adding Iodide to the cuvette after sufficient progression of the reaction to determine if amylase is present in the sample solution.

The results were also used to propose a theory for the hydrolysis of the polysaccharide (starch) bond by the enzyme alpha-amylase. In the proposed theory, the amino acids of the active site, a significant one being histidine, change the conformation of the starch bond so as to induce the loss of the bound iodide, and subsequently the enzyme is able to hydrolyze the bond. Of this two-step process, the first step, the interaction of the active site amino acids and the starch bond, is that which is being observed when histidine is introduced to starch-iodide in solution.

*Third Award - ISEF/Biochemistry

SPECTROSCOPIC ANALYSIS OF STRUCTURAL AND FUNCTIONAL CHANGES IN VENOMS TREATED WITH HIGH VOLTAGE ELECTROSTATIC INDUCTION

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Proton nuclear magnetic resonance, infra-red, and ultra-violet (uv-vis) spectrometry were used to characterize structural and functional changes in the venoms of the Southern Cottonmouth snake (*Agkistrodon piscovorus piscovorus*), the common honey bee, and in two componants of bee (*Apis mellifera*) venom, procaine and melittin, after treatment with 100kV electrostatic charges. This is a method modified from that proposed by researchers in Ecuador using the venom of the *fer de lance* snake, commonly called the bushmaster, showing in forty clinical cases that high-voltage electrostatic charges destroyed the action of the venom, even after delays in application of the treatment of up to one half hour.

Loss of venom action on bovine blood substrates was evident in hydronium (pH) fluxes in *Apis* venom and procaine while *Agkistrodon* venom changed significantly in pH but lost little activity. All samples showed spectral decomposition in the range of 340-600nm, with melittin loosing all absorptive properties.

Overall, the method of using high-voltage electrostatic induction appears to have a direct effect on lessening the activity of venoms in blood systems, though the actual mechanisms are still unknown. The degradation of venoms treated by high-voltage induction may be caused by changes in the tertiary structure of venom peptides arising from changes in the pH of the surrounding environment (solution or buffer system).

The Enhancement of Methane Production From the Red Seaweed, *Gracilaria tikvahiae*

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This study investigated different possibilities to enhance methane production from the anaerobic digestion of the red seaweed, *Gracilaria tikvahiae*.

The effectiveness of the different microbial innoculums saltmarsh sediments, freshwater sediments, and anaerobic sewage sludge were tested to determine which best produces methane. It was revealed that saltmarsh sediments was the most optimal innoculum for producing methane from *Gracilaria tikvahiae*.

The transition metals: cadmium, iron, nickel, and molybdenum were introduced into the digesting material. Transition metals can catalyze and enhance methane production because transition metals have special properties arising from the presence of outer d orbitals which make them suited for binding gases and other substances. Cadmium was found to best catalyze and enhance methane production.

Gracilaria tikvahiae pressure heated or microwaved before being digested. Both thermal pretreatment methods increased the biodegradability of the seaweeed therefore enhancing methane production.

The amine solutions: monoethanolamine(MEA), diethanolamine(DEA) triethanolamine(TEA), and dimethyl cyclohexalamine were used to purify biogas and increase methane concentration by scrubbing acid gases (H_2S and CO_2) from biogas. Biogas was scrubbed by bubbling it through the amine solutions. MEA was found to the most efficient solution to scrub unwanted biogases.

#First Award - Midwest Research Institute, through its division, the Solar Energy Research Institute
First Award - U.S. Department of Energy
Third Award - ISEF/Biochemistry

A TWO YEAR STUDY ON CALCIUM AND ITS EFFECT ON THE ABSORPTION RATE OF ASCORBIC ACID IN THE CAVIA PROCELLUS METABOLISM

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Analytical studies were conducted on the metabolism of the Cavia porcellus, more commonly known as the guinea pig. The absorption rate of ascorbic acid (vitamin C) was explored through a controlled diet and a controlled intake of ascorbic acid and calcium carbonate ($CaCO_3$). The Cavia porcellus was used for experimentation due to the fact that they are excellent animals for experimental purposes, for they are one of the few species that do not synthesize their own level of ascorbic acid. Experimentation was performed on three graduated intakes of calcium carbonate and a controlled intake of ascorbic acid. One sample was used as a control group with only an ascorbic acid intake. Experimentation on each sample was performed once daily for ten consecutive days with a titration endpoint of the amount of ascorbic acid that was utilized. The maximization or minimization that calcium carbonate has on the retention rate of ascorbic acid was calculated by directly titrating the excretions of urine and fecal material with the dichloroindophenol sodium salt solution (dye). Discoveries concluded that calcium does have an effect on the absorption rate of ascorbic acid in a cytologic metabolism. It was concluded that the higher the level of calcium carbonate induced in the system, the lower the amount of ascorbic acid left in the system. Therefore, calcium does play a role in the depletion of ascorbic acid in a metabolic process.

#THE EFFECTS OF RETINOL DEFICIENCY ON GENE EXPRESSION IN A RAT LIVER CELL

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Vitamin A deficiency is a growing problem in Third World countries. Lack of vitamin A-rich foods can cause widespread deficiency whenever the food supply drops. Deficiency of vitamin A can lead to deterioration of epithelial tissues, decreased immunity, and other complications including blindness.

Prior to the growth of molecular nutritional studies, these efforts generally led to dietary supplementation as a solution. Now with the availability of biochemical studies, it is hoped that by better understanding the functidns of vitamin A, an easier solution may be found.

A study was made to examine the effects of deficiency of retinol, vitamin A alcohol, on gene expression in a rat liver cell (Sprague Dawley). A cDNA library consisting of the total mRNA of a rat liver cell which had been copied into cDNA form and inserted into lambda gtll bacteriophage was obtained and analyzed. Through hybridization techniques using cDNA probes made from the mRNA of both normal and retinol-deficient animals, several genes were found whose expression is increased by deficiency. After four repetitions of the screening techniques had been performed to verify results and to isolate the clones whose expression was differentiated by deficiency, two of these clones were chosen to be subcloned into plasmids to be used as a source of cDNA for further experimentation. These further experiments have thus far shown that results were not animal-specific, and that expression increases by about five-fold in deficiency and returns to normal when levels of retinol are restored, as was expected based on studies which have shown physical and molecular symptoms of deficiency to lessen with repletion of vitamin A. Future studies will include sequencing of each gene and hopefully will lead to determining which proteins are affected by deficiency, which could possibly lead to an alternative to supplementation for the solution of vitamin A deficiency.

#First Award - Eastman Kodak Company

FERMENTATION OF SUGARS TO PRODUCE H2 BY A CYANOBACTERIUM

WANDA RODRIGUEZ
COLEGIO NUESTRA SEÑORA DE BELEN
ST 18 WW-1 JARD. DE CAPARRA, BAY. PR

Because hydrogen is a clean fuel its use as a fuel would lead to decrease air pollution. The objectives in this investigation is to increase and measure the production of hydrogen by a cyanobacterium by altering its metabolism. In this research I will use the strain ANABAENA VARIABILIS, classified as SA-0.

The procedures to follow are simple. Innoculate 8 bottles with the cyanobacterium strain. Degass the bottles using a vacum pump. Replace the air with ARGON GAS. The argon gas is used in this experiment because it is an inert gas which will not react with the cyanobacteriums products. Expose bottles to direct light at room tempertures for intervals of 24 hours. Between each interval, 50 microliters of gas are injected into a gas chromatographer. The hydrogen produced will be quantitated by an integrator.

In the future hydrogen produced by this method could be used as a safe and inexpensive source of fuel for future rocket launches by NASA. Conceivably,it could replace some or all of the USA requirements for natural gas and trasnportation fuels. The data collected so far indicates succes in the production of hydrogen, a feat which has never been accomplished before.

*COOPERATIVITY AND COMPETITION:C-TERMINUS OF A1 PROTEIN AND NUCLEIC ACIDS

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I investigated properties of the C-terminus of A1 protein, a representative core protein involved in splicing hnRNA to produce mRNA. The properties I explored included cooperativity (binding in relation to neighbor proteins) and competition among nucleic acids for C-terminus. Cooperativity experiments yield information on the structure of A1 protein. By constructing a working model of this protein, it could be possible to predict interactions between proteins and nucleic acids. I investigated the competition between nucleic acids for C-terminus hoping to find a synthetic acid that could struggle with hnRNA, thereby inhibiting splicing and production of mRNA.

Since C-terminus fluoresces more when bound to poly(eA), I was able to monitor the binding on a spectrofluorimeter. I then constructed best fit curves that compared moles of bound protein/mole of poly(eA)(=nu) to nu/moles of unbound protein. From these plots, I determined the cooperativity and association parameters. In evaluating competition, I compared the amount of C-terminus needed to saturate solutions of several nucleic acids.

I deduced from my experiments that the C-terminus of A1 protein binds cooperatively to and has a very high affinity for nucleic acids. This protein proved to bind best to poly(eA), but also bound well to high concentrations of poly(rU) and poly(dT). Thus by saturating or diluting hnRNA with C-terminus (it depends on whether C-terminus is necessary to splicing), the production of mRNA can be inhibited in virus-infested areas.

*Fourth Award - ISEF/Biochemistry

POLYACRYLAMIDE GEL ELECTROPHORETIC CHARACTERIZATION OF PLANT TISSUE CULTURE PROTEINS

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The purpose of this research was to determine if the protein produced during plant tissue culture compare to the proteins produced during normal growth. An electrophoresis chamber was constructed using plexiglass, banana plugs, and platinum wire. Proteins were extracted from carrot tissue cores and carrot callus. The proteins, along with 6 known molecular proteins were electrophoresed in a 10% polyacrylamide SDS gel for 5 hours at 5 ma. The gels were stained, destained and dried between dialysis membrane.

After several attempts, gels were obtained that had protein bands evident. The bands of protein produced were not very defined. This may have been caused by the low quantity of protein in the sample. Plans are to concentrate the proteins in dialysis tubing coated in Aquacide. A greater gel concentration may also help to concentrate the bands more. The carrot callus and carrot appeared to produce many similar bands. There appeared to be some differences in terms of faint bands being present in carrot callus vs the carrot protein profile. This may mean protein differences or differences in the concentration of protein exist between the carrot and callus tissue.

WHAT ARE THE EFFECTS OF CIGARETTE SMOKE ON METABOLIC ENZYMES?

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My investigation began with putting cigarette smoke into an aqueous solution by means of a self-designed device. This process involved drawing the smoke of 5 cigarettes through 50 ml of water by means of a water aspirator. This was done for four types of cigarettes: filtered, king size, unfiltered, and menthol. These solutions were then introduced to a metabolic reaction controlled by the enzyme alcohol dehydrogenase. The reaction itself changed NAD+ and ethyl alcohol into NADH+H+ and acetaldehyde. While the reaction was taking place, I constantly measured the absorbency of the reagents and resulting products at 340 nm. A spectrograph of a solution of NADH is normally very high at 340 nm so if the spectrograph taken during the reaction rose rapidly, there was a lot of NADH being produced. By comparing the resulting spectrograph with a control, I could observe the activity of the enzyme (by seeing how much NADH was being produced). My results indicated that cigarette smoke did effect the activity of alcohol dehydrogenase. The only immediate hypothesis as to why this happens is that nicotine, which has a similar structure to NAD+'s, is competing with NAD+ for the alcohol dehydrogenase.

A STUDY OF CRUDE POLYPHENOL OXIDASE FROM WHITE POTATOES

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The enzyme polyphenol oxidase (PPO) is responsible for the browning color that occurs in different fruits and vegetables. PPO and phenolic compounds are physically seperated in the cell, however, when these cell tissues are torn apart, cell contents become disorganized and oxygen is permitted to come in contact with the mixture. The enzymes catalyze the oxidation of phenolic compounds and browning occurs.

When foods are prepared for consumption, discoloration, such as browning, is undesirable and inhibitors are applied to the food to prevent or retard browning, or conditions such as temperature or availability of oxygen are changed to retard the reaction.

The purpose of this study was to determine the conditions in which the enzyme polyphenol oxidase had maximum activity or no activity. Assays such as the effect of varying pH, varying temperature, reactions with different substrates, varying enzyme concentration, varying substrate concentration, chelating agents, and possible inhibitors of crude polyphenol oxidase from white potatoes were performed.

The polyphenol oxidase had maximum activity at pH 7.0 and at temperature of 20°C. The enzyme showed greater activity in catalyzing the increase in absorbance of a reaction mixture containing catechol. Phenyl thiourea, which chelates copper, prevented the reaction from occurring. Sodium bisulfite and sodium benzoate were equally effective in inhibiting the reaction.

THE ROLE OF COPPER IN THE REGULATION AND ACCUMULATION OF SUPEROXIDE DISMUTASE IN RAT LIVER AND LUNG

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The role that cofactors play in influencing the expression and net accumulation of their related proteins and enzymes is an important area of nutritional investigation being pursued at the present time. In this regard, this study was designed to investigate , immunologically and enzymologically, the role of copper in regulating the net accumulation of liver and lung Cu,Zn superoxide dismutase (SOD) and its enzymatic functional activity in Cu-deficient and Cu-sufficient.

Twelve pregnant female Sprague Dawley rats were fed diets that were sufficient or deficient in copper. The dams were fed throughout gestation, parturition and lactation. The pups were then killed postnatally at day 20 and day 40. The livers and lungs were removed from the pups and homogenized for eventual using assays for SOD. The rats were compared ie, copper deficient and copper sufficient rats at day 20 and day 40. The net accumulation of SOD, and protein in liver and lung from the two groups showed no differences. Other data revealed, however, that the SOD liver enzymatic level is reduced in copper deficient rats to one-half normal. Trace element assays showed the experimental group, copper deficient, had .23 ug(Cu)/ml. plasma while the control group, copper sufficient, with 1.12 ug(Cu)/ml. plasma. The hematocrits were also determined at day 40. The values were Cu-deficient rats (23%) and Cu-sufficient rats (42-47%).

An important observation was that the hearts in the copper deficient group was 26% larger than the normal group at day 40. The body weights were not different at day 10 between two groups. However, at day 20 the body weights were different. The copper deficient rats were 82% of the weight of normal rats. With respect to SOD, the data show that copper, SOD's enzymatic cofactor, does not affect its tissue accumulation, although functional activity is decreased.

#Third Award - ISEF/Biochemistry

THE EFFECTS OF PANCREATITIS AND PH ON OPTIMAL ENZYMATIC REACTIONS IN CANINES-A TWO-YEAR STUDY

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The title of my project is "The Effect of Pancreatitis and Ph on Optimal enzymatic Reactions in Canines: A Two-Year Study." Every year, many canines suffer from these symptoms: vomiting, low grade fever, diminished bowel activity, restlessness and cold, sweaty extremities. These symptoms are caused by the disease Pancreatitis.

The purpose of my project is to determine how the increased Amylase and hydrochloric acid levels caused by Pancreatitis affect the optimal enzymatic reactions in the canine digestive process.

To determine these relationships, I conducted twenty-five, controlled laboratory tests varying both amylase concentrations and substrate Ph levels to determine the conditions necessary for optimal enzymatic reactions. I then analyzed blood-serum samples to determine the amylase levels produced by the pancreas in both normal and pancreatic canines.

Results of all tests were compared to predict the effect of pancreatitis on the canines' optimal digestive enzymatic reactions. Based on the laboratory results and blood-serum tests, it is known that pancreatic canines have an average amylase level 760.24 IU/L (International Units per Liter). A normal canine has the amylase level of 405.25 IU/L. Therefore, a pancreatic canine has an average of 355% more amylase than a non-pancreatic canine.

This should cause a 108.61% increase in enzymatic reaction times. In turn, the health of canines will deteriorate accordingly.

# ROTATIONAL GEL ELECTROPHORESIS

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DNA fragments have historically been separated by the process of gel electrophoresis. A shortfall of the technique is that the larger fragments cannot be resolved. To improve the resolution, the direction of the electric field used to move the fragments has been varied using switched electrode arrays. This study, for the first time, rotated the gel inside the field instead of changing the electrode configuration, which allowed the field direction to be infinitely varied in any time sequence. Fragments move from side to side in a snakelike fashion, thereby avoiding becoming trapped or "hung up" in the gel. The technique successfully increased the mobility of the Lambda Hind III digest and uncut Lambda (less than 50 kilobase pairs) and allowed the resolution of yeast chromosomes above 200 kilobase pairs. Original software was developed to control a stepper motor through an Apple IIe game port which rotated the gel turntable.

***First Award - ISEF/Biochemistry**
First Award - Patent and Trademark Office/U.S. Department of Commerce/Patent and Trademark Office Society
Honorable Mention - American Chemical Society

THE EFFECT OF VITAMINS ON SOYBEAN GERMINATION AND PLANT GROWTH

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For this project, vitamin B-1, B-6, B-12 and C were used in two amounts, 50 and 100 milligrams. These amounts of each type of vitamin were dissolved in ten milligrams of distilled water and placed in petri dishes. A control group using only water was also used. They were then set under grow lights. The grow lights were turned on every day for a twelve hour period to simulate normal daylight hours. Their root length, stem size, and appearance were monitored and recorded along with the length of time it took the seeds to germinate. To discover the effects vitamins had on the growth of the soybean plant, my procedure changed slightly. Soybean seeds were germinated in water until the first leaf appeared. Then the plants were planted in potting soil and watered every day with ten milligrams of water containing fifty milligrams of the vitamin. This was also done using 100 milligrams of each type of vitamin. A control group given only water was also added. The plants were under grow lights for a twelve hour period daily, and the size of the leaves and stem, along with the general appearance of the plant, were monitored.

CYTOCHROME B_5 FROM BOVINE HEART: PURIFICATION CHARACTERIZATION AND ISOZYMIC PROPERTIES

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In this study it was shown that an abundant amount of cytochrome b_5 could be isolated from the soluble fraction of the homogenate of Bovine Heart. The enzyme was purified to apparent homogeneity by column chromatography and characterized. A molecular weight of 32,000 daltons was determined for the native enzyme. Electrophoresis of the enzyme in the absence and presence of sodium docecyl sulfate (SDS) revealed the property of molecular homogeneity. Four isozymic variants were observed. In the presence of SDS, the enzyme migrated as a single polyoeotide with a mobility which corresponded to a molecular weight of 15,000 daltons. The tendency to aggregate upon prolonged exposure to SDS was observed, Saturation with molecular oxygen caused a decrease in the absorbance maxima of the alpha and beta peaks, and the carbon monoxide almost irreversably abolished the alpha absorabance maximun. Spectral absorbance maxima of cytochrome b_5 were observed at 575 nm, 535nm and 412 nm for the alpha, beta and gamma peaks of the reduced enzyme.

A CHEMICAL CLINICAL STUDY OF THE Tournefortia gnaphalodis WITH EMPHASIS ON ITS ANTIASTHMATIC PROPERTIES

Lopez, Ronald. Dr. Carlos Gonzales H.S. Aguada, Puerto Rico
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The plant Tournefortia gnaphalodes better known by the name of tea of the sea is a shrub native of the South of Florida. This plant is natural and common on the sea shores and sandy territories.
Starting the investigation, a pre-study was done by means of a questionnaire to determine how well known was the plant in Aguada, Puerto Rico. Later, its habitat was studied and dry leaves and stems were carried out to the laboratory for its chemical analysis using atomic absotion. In this analysis we found that the plant has 10.4 ppm. of iron and 8.15 ppm. of nickel., 21.4 ppm. of zinc.
To determine the antiasthmatic properties of the plant on Cavia porcellus, guinea pigs, were used. Three groups of ten(10) were used. These groups were divided into a group of 20 experimental and 10 contol.
An asthmatic condition was provoked to them by injecting .3cc of histomine phosphate. Dr. Walter Banch injected the substance and I observed.When the specimens presented the asthmatic symptoms, an infusion of the plant was given under the supervision of the doctor.
The asthmatic symtoms were reduced and their respiratory rhythm returned to the normal condition.

HORMONAL EFFECTS ON THE CARCINOGENESIS OF CROWN GALL TUMORS: PHASE II

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This is a second year study of a cancerous plant condition called crown gall disease. Crown gall tumors develop after Agrobacterium tumefaciens, a soil-borne bacteria, invades wounded plant tissue. Crown galls restrict normal plant functions in similar fashion to human cancer.

Phase I hormones, gibberellic and naphthaleneacetic acids, were not successful treatments. In Phase II, abscissic acid, a growth inhibitor to slow tumor development, and gibberellic acid, a growth stimulator to speed up normal cell development, were the hormones utilized. My hypothesis stated that absicissic acid would be most successful. The purpose was to compare the effects of these hormones on normal and abnormal plant tissue development.

Thirty-six Burpee Pixie Hybrid tomato seeds were germinated, maintained, and placed in six equal groups. Groups A, B, and C were control groups and D, E, and F were treated with the appropriate hormones. Groups C, D, E, and F were all infected with Agrobacterium tumefaciens. After six weeks of daily treatment, total success was not noted. The plants in Phase II had galls develop, but the survival rate and plant condition was significantly better than Phase I. The most noticeable side effect of abscissic acid treatment was smaller plant size.

Further investigation of natural plant hormones and different dosages may prove to be more successful in solving this disease.

A CORRELATION BETWEEN MUTAGENESIS AND CHEMICAL STRUCTURE

Gray, Katie

PHASE III: SOME AROMATIC AMINES (Year 2)

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Year one focused on the effect the number of rings had on the compound's mutagenicity. In year two, the effect of the amine group position on the ring was compared to the mutagenicity. The amine group was moved around two basic structures: fluorene and naphthalene. A few diamines were tested to determine the effect of the added amine group on the compound's mutagenicity.

The following compounds were tested in the fluorene series: 1-aminofluorene, 3-aminofluorene, 4-aminofluorene, 9-aminofluorene, and 2, 7-aminofluorene. The following compounds were tested in the naphthalene series: 1-aminonaphthalene, 1,5-diaminonaphthalene, 1,8-diaminonaphthalene, and 2,3-diaminonaphthalene.

The procedures were done in accordance with the *Salmonella*/microsome mutagenicity assay.

The results indicated two strong position/activity relationships: (1) an added amine group reversed the mutagenicity of a compound; and (2) a compound with the amine group lying on the longest axis has a higher mutagenic activity than that of a compound with the amine group not lying on the longest axis.

THE SEX DETERMINATION OF HUMAN HAIR SAMPLES

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There are many things that can be determined from hair at the scene of a crime: whether it is cut, broken or pulled; the race of its owner; whether the hair is human or animal; if it is dyed; its color; and the area of the body from which it came. The purpose of this research is to determine the sex of an unidentified hair specimen using a differential staining technique. Currently, the procedure being used includes the staining of the root follicle with quinacrine mustard. This stain attaches to the chromosomes in the cells and makes them visible under a fluorescent microscope. This staining procedure is time consuming and tedious. In my procedure male and female hair samples were collected. Each hair was tested with different substances and their appearance was noted under a microscope. In the initial investigation one stain tended to differentiate male from female. Further research involving 120 more hair samples was done using this stain, with positive results. Present investigations include double blind tests to check the significance of this procedure. Further investigations include comparisons of certain animal hair, as well as other forms of human body hair.

BOTANY

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ANALYSIS OF THE ROTIFER-VAUCHERIA ASSOCIATION

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The experimentation was designed in an attempt to gain a clearer understanding of the rotifer-Vaucheria association. In this relationship, the rotifer, Notommata Werneckii, dwells is tubercular excrescences within the walls of the Vaucheria Geminata, a green filamentous alga. It was hypothesized that the rotifer-Vaucheria association isn't a parasitic relationship but a symbiotic one. To test this, experiments were designed to determine the effects of each member of the association on the other. These included a comparison of oxygen production of rotifer-infested and non-infested Vaucheria cultures, a chlorophyll content comparison of both cultures, and tests to determine if rotifers could live apart from Vaucheria. The results of the experimentation support that these two organisms benefit each other in the association and therefore can be classified as being symbiotic. Also, other research was done that uncovered the methods by which a rotifer enters a Vaucheria filament and trials to see what species of Vaucheria could support rotifers. Furthermore, since rotifer-infested Vaucheria produced more oxygen and food, it was established that this unique association is beneficial to its surrounding habitat.

*Second Award - ISEF/Botany

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INTENSIVE POLYCULTURE

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Intensive versus extensive are two new terms used to describe aquaculture today. Extensive aquaculture has been described as the raising of fish in natural bodies of water. Intensive aquaculture is the raising of fish in high density systems. These systems usually require high energy output and increased dissolved oxygen content (Klosterman 1987). Intensive systems must develop a way to filter waste and to increase dissolved oxygen. This system uses wet-dry filtration to rid itself of the toxic wastes and add dissolved oxygen. This system has proven to be more efficient than any other present day aquaculture system. Both the dissolved oxygen and the nitrification capabilities enable this system to out produce present day aquaculture. Nitrates are the end product of the nitrification process and this system has an excess of them. The excess nitrates were used to grow plants by hydroponics. The various plants were used experimentally as a second crop to determine which had the greatest potential to absorb nitrates. Thus by using various crops with the aquaculture system a polyculture system developed that was very efficient. HYPOTHESIS: The use of plants in a polyculture system will maximize the efficiency of an intensive aquaculture system.

*Fourth Award - ISEF/Botany

*ASPECTS OF CECIDOGENESIS BY EUROSTA SOLIDAGINIS IN THE TALL GOLDENROD PLANT (SOLIDAGO ALTISSIMA): A FOUR-YEAR CONTINUING STUDY

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The fourth year of this project involved an eight-month field and experimental period; the processing of 3,001 tall ungalled and galled goldenrod plants (Solidago altissima) for fluid, conductivity, and tissue studies; the comparison of 1,130 plant measurements; a comparative analysis of 36 pH and 36 conductivity readings; the statistical analysis of goldenrod measurements, conductivity and fluid readings; the evaluation of 136 histologic goldenrod slides; the preparation of 20 thin-layer chromatographic (TLC) plates; and, the analysis of nuclear magnetic resonance (NMR) spectra of goldenrod tissue fluids.

This project's purpose is to study cecidogenic (gall formative) aspects by Eurosta solidaginis on goldenrods through: emergence patterns; chemical analysis and examination of pH and conductivity of galled and ungalled fluids; analysis of histologic slides of ungalled and galled stem tissues; and, interpretation of goldenrod measurements.

A sample of 1986-1987 local overwintered globular galls only manifested emergences (44%) in May, 1987 by E. solidaginis. Twenty-eight percent of the larvae/pupae of 1987-1988 overwintering globular galls did not develop.

During cecidogenesis, ungalled goldenrod fluid is more acidic than galled goldenrod fluid. Cecidogenesis decreased goldenrod conductivity whose pattern appears to be an inverse of the pH pattern.

Cecidogenesis stunted the height of developing goldenrods and affected inflorescence. In some cases, galled diameters increased by 800% when compared to ungalled diameters.

Several histologic differences were noted between galled and ungalled stem tissues. NMR spectra revealed the presence of glutamic acid only in galled stems. Bioassays are contemplated to ascertain glutamic acid's cecidogenic role vis-a-vis E. solidaginis.

*First Award - ISEF/Botany
First Award - Sigma Xi, The Scientific Research Society
Second Award - Patent and Trademark Office/U.S. Department of Commerce/Patent and Trademark Office Society
Third Award - Entomological Society of America
Honorable Mention - Eastman Kodak Company

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* PLANT REGENERATION USING SOMATIC TISSUE FROM GOSSYPIUM HIRSUTUM L.

WENDY YEE
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Cotton is one of the few species for which a "standard" for induced somatic embryogenesis has not been developed. Previous methods, or protocols, have produced plants whose fertility rates fell well below what was required for further gene studies. Two protocols for inducing somatic embryogenesis were evaluated, one involving plate-liquid suspension culture, the other solely plate culture. Both were based in part upon the 1986 protocol originally developed by Trolinder and Goodin (Lubbock, TX), chosen because it had produced the highest degree of reproducibility and the greatest percentage of surviving tissue for cotton at this time. The amount of time spent "in culture" is crucial in determining the rate of fertility in the resultant plants. Major modifications were made to Trolinder and Goodin's involving the application of growth regulators, use of liquid suspension, and plant regeneration procedures. 2,4-D, kinetin, IAA, and NAA are the primary growth regulators in use. Most notably, a dehydrative from second-generation embryos. This shift in the osmotic potential of the tissue involved encourages maturation. Before this, irregular root formation and mutation were common. Mature plants have been obtained through this procedure. The process is currently under refinement and is expected to be applied in the area of genetic transformation research.

*First Award - American Society of Agronomy

*PHOTOTROPISM

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Phototropism is the term which describes plant reactions to different light conditions. I am using various light colors (white, red, yellow, green, violet, and black) to observe the behavior of plants in accordance with the size of the leaves and the stems, the color of the plant, and the overall healthy or unhealthy appearance of the specimen.

After collecting data on a plant protein (phytochrome) that serves the role of an enzyme in directing plant growth and on the absorption of colored wavelengths by the phytochrome, I formed my hypothesis. Allowing the plant receiving the white color (in actuality, it's normal sunlight) to be my control, I hypothesized that the plant placed in the violet light will have the most favorable results. Following, in order of their reactions, will be the plants in the red, the yellow, and the green. Black light will trigger no living plant response.

Three cabbage seeds are planted in each color; my display is placed in a window allowing all the plants to receive equal sunlight and heat. They are watered every night with two tablespoons of water (tap) and fertilized one time to assure proper nutrients are available. The most developed plant in each color will be the one displayed.

Performing my experiment once with bean plants and twice with cabbage plants, I am able to conclude that my hypothesis is supported. I can also determine which color combinations will have the best results on different plant types.

*First Award - National Aeronautics and Space Administration

A Bioassay for Uniconizole

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The purpose of this project was to develop a bioassay for Uniconizole for use in determining the amount of Uniconizole in plant parts, and soils. Uniconizole is a plant growth inhibiting hormon. Uniconizole apparently stops the synthesis of gibberellins, which promote cell elongation.

A 500 ppm. solution was made from a five percent solution. Then serial dilutions of one to ten yielded the concentrations, 500 ppm. through .05 ppt. Two week old bean plants (*Phaseolous vulgaris* variety kentucky wonder) were injected, in groups of three and four plants per concentration, with two units from a hypodermic syringe. Several experiments revealed that the best site for injection is the first node. Injections below the first node were injected into the hollow portion of the stem, thus not into the vascular system. Measurements were taken at the time of injection and again after two weeks. The change in height, as a function of the concentration of Uniconizole, was plotted on a graph.

Uniconizole is soluable in ethanol. Extractions from plants and soils are made easy because of this solubility. After the extraction, the solution can be run through the bioassay to determine the amount of Uniconizole present. Knowing how much Uniconizole is present will allow experiments to determine the amount of Uniconizole in various plant parts, and Uniconizole's persistence in soils. This information will help prevent harm due to overdosing in fruit trees, grains, and other plants.

* ELECTRO SOW GROW

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The purpose of this project is to explore the field of electroculture. Electroculture is the application of electricity on plants. This project compares the rate of germination, development, and appearance of the tomato and coleus plants, respectively, to the control of the two when a continuous D.C. electric current is divided between the containers. Research is gathered and materials are found to construct an apparatus. Included among these materials is the wood, copper wiring and strips, rheostats, switches, meters, and a 12-volt battery with a trickle charger. After this, the kind of soil and plants are decided upon. For each trial, nine Bitsy hybrid tomato seeds are planted in two containers. Also, nine coleus, Saber Pineapple, are sowed in the other two containers. Both ten and five milliamperes are passed through each of the two planters. Measurements of the plants are recorded.

Using the t Test, the results of the experimental plants were compared to the plants of the control. The experimental plants germinated significantly faster and grew significantly more at the .05 level of confidence. Therefore, electricity on plants does make a difference. Each current level tested affects both tomato and coleus in a positive way.

Electroculture, in which little is understood, is thought to stimulate growth hormones, enzymes, roots, and/or warm the soil. This experiment shows and proves this fascinating innovation. Possible applications might be control of crops, grasses, and trees.

*Honorable Mention - National Aeronautics and Space Administration

* REFRIED RADISHES II

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In past experiments, it has been found that radish seedlings exposed to intense bursts of infrared light sprout at a fantastically higher rate and frequently develop blighting symptoms apparently due to a collapse of the pith and the cortex of the stem. This blight, because of its striking resemblance, was hypothesized to be a plant disease caused by the _Pythium_ fungus; however, certain characteristics suggested other possibilities. Experiments were conducted to test this hypothesis by subjecting separate groups of radishes to the following conditions: (A) those known to be inductive to _Pythium_, (B) the infrared light stimulus known to cause the observed phenomenon, and (C) both conditions known to cause _Pythium_ and the infrared stimulus known to cause the phenomenon. Numerous experiments dealing with variations of these conditions were also conducted to test individual characteristics; also, plant tissues blighted under the infrared radiation stimulus were smeared on nutrient agar with attempts of culturing any fungi present. The results of these experiments were compared and contrasted with those of control groups, exposing remarkable revelations. All findings pointed away from the existence of a fungus causing the blight; nevertheless, conditions were stumbled upon which stimulated the plants' sprouting rate between 400 and 1000 percent of normal. In addition to these results, a procedure was found that could increase the growth rate of the plants up to 100 percent.

*Fourth Award - ISEF/Botany

CHLOROPHYLL PRODUCTION AS AFFECTED BY MACRO ELEMENTS

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The objective of my research project was to determine if the chlorophyll production in barley and bean plants was affected by macro-elements. Elements used were nitrogen, potash, phosphorous, and magnesium sulfate. The plants were grown in an inert substance known as vermiculite. I had a nitrogen, potash, phosphorous, magnesium, and control group, and a group of the three major elements combined. After they grew with distilled water for a short period of time, they were subjected to concentrations of the elements in distilled water.

After the plants had grown, I was able to do a quantative chlorophyll analysis using spectrophotometry. Results showed that barley and bean grown alone with the 46-0-0 (nitrogen), the 0-46-0 (phosphorous), and the 0-0-60 (potash), had less chlorophyll than the combined group and also less than the magnesium test group. In conclusion, plants grown with a stable fertilizer or the trace element would produce the most chlorophyll, consequently the most oxygen.

The intent of this and further research is to maximize oxygen production for space travel while minimizing nutrient weight and space.

EFFECT OF STRATOSPHERIC OZONE DEPLETION ON PLANT GROWTH

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This project studied the possible effects of the depletion of stratospheric ozone content on the growth of vegetation. The increase in ultraviolet radiation that would penetrate the protective layer would increase greatly with the ozone loss. Before my study began, I hypothesized that the increase in ultraviolet light would have a definite negative effect on the plant growth. This study began with three specimens of each of three plant species. One member, from each species, was exposed to a 75 watt ultraviolet source: A second member, from each species, was exposed to a 450 watt source: A third member, from each species was kept as a control. Observations were made each day. After approximately three weeks of exposure, negative effects, mostly leaf damage, became visible in the treated specimens. Differences in leaf growth and in plant sizes were observed, with the exposed plant having "stunted" growth and quite extensive leaf damage. Photomicrographs were taken to closely observe the ultraviolet effects on the tested specimens and others were taken of the control for comparison; in these photographs the leaf damage was clearly seen. The results of this study indicates that further destruction of the ozone layer could lead to a major problem with the world's food crop production.

EFFECTS OF RADIATION ON SACCHAROMYCES CEREVISIAE

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Phase 1 - 1987 Fermentation In this experiment I examined effects of 400 mas x-ray, 450 rads cobalt 60 radiation when applied to dormant baker's yeast, *Saccharomyces cerevisiae*, then combined with commercially bottled apple, apple cherry, apple grape, grapefruit, pear, red grape, white grape juice samples. A control for each juice using untreated yeast was prepared. Results showed a slight increase in length of fermentation time for irradiated yeast in some cases.
Phase 2 - 1988 Fermentation To expand last year's work, baker's and wine yeast were treated with 100, 300, 600 rads linear acceleration. Using 1/4 teaspoon each irradiated yeast was placed in solution with 10 ounces freshly squeezed apple, red grape, white grape juice. Untreated yeast was used to prepare control for total of 24 samples. Using a hydrometer, I determined specific gravity, potential alcohol, sugar content of each solution before fermentation. After fermentation, I determined specific gravity, alcohol content, sugar content. In both types yeast which received 100 rads most samples showed higher alcohol content, decreased specific gravity, and decreased sugar content after 17½ hours when compared with control. Yeast's performance was generally deterred in solutions involving higher levels of radiation.
Phase 2 - 1988 Colonization Using baker's and wine yeast treated as last described, I combined 1/8 teaspoon with autoclaved water and heated to activate yeast. I then streaked blood agar with solution and incubated plates at 37° C. to culture and compare yeast colonies. Because of contamination, few conclusions could be drawn.
Phase 2 - 1988 Reproduction Using the two types yeast treated as for all of this phase, I combined each with cane sugar then honey and heated to activate. I prepared/stained slides for microscopic comparison of cells. To date, concrete conclusions can not be drawn.

GENETICS AND CYTOLOGY OF A MECHANISM OF MALE STERILITY IN ALFALFA

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This project analyzes and develops a biologic system that produces genetic male sterile alfalfa (medicago sativa). First, meiosis in the mutant strain and in a normal diploid strain were observed and documented. Upon comparison, it was observed that the pollen in the mutant strain failed to seperate after meiosis. These large pollen, called "jumbo" pollen, are incapable of fertilizing an egg cell. Thus, the plant with trait is effectively male sterile.

The second portion of the research was to determine the nature of inheritance of the jumbo pollen mutation. A cross of a mutant with a normal plant was made. Pollen from the F_2 generation plants was collected and counted by size to determine the pheneotype of each plant. 18 of the 27 plants were normal. Hypothesizing the trait to be recessive, the chi-square test was applied and the results found to be statistically signifigant.

These plants are usefull for alfalfa research for two major reasons. Because they are incapable of self-fertilization, lab procedure is simplified. No tedious vacuum removal of pollen is necessary. More importantly, results of other crosses are much more accurate, because it is certain that the result could not be because of self-pollination

"DO FIELDS AFFECT FIELDS?"

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Opp High School
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The purpose of this experiment was to evaluate the effects magnetism has on the growth of plants. There has been some research done to determine whether growth can be stimulated by a magnetic field.

For this experiment two planted groups were studied--control and magnetized. Each group consisted of six (6) florunner peanut seeds. The seeds were first sprouted in order to insure viability. The plants were maintained under lab conditions in Climatariums with identical light and temperature. At the end of three weeks of growth, both groups were measured, weighed, and compared. This process was repeated three times to insure more accurate results.

The results showed that a remarkable difference was evident between those not exposed to a magnetic field and those exposed to a magnetic field. The magnetic group consistently grew larger and at a faster rate.

Corn Physiology III: Pollen Delay

Mark McCully
Mid-County Jr./Sr. High School
RR 2 Varna, IL 61375

The main objective of this study was to find chemical sprays that would delay corn pollen release for use in seed corn production.

I started in early July by locating chemicals that would delay maturity in corn plants. The chemicals chosen were Fusilade, Basagran, Gibberillic Acid, a 28% Nitrogen solution, Bladex, and Crossbow. A second trial was conducted, using Bladex, Fusilade, Cerone, and a 2, 4-D/Banvel mix. Unreliable results were obtained from the second trial because the plants treated were beginning pollination before before the chemicals were applied.

The third trial was conducted on a later maturing field by applying the chemicals with hand sprayers. Two different rates were used: one was the recommended rate and the other was three times the recommended rate. After collecting data on the plants that had not started pollinating, the plants actively pollinating, and the plants that had already pollinated, Cerone and Bladex tended to delay pollen shed while Fusilade and the 2, 4-D/Banvel mix hastened pollen shed. While additional testing is needed for verification, spraying Cerone shows promise as a method to delay pollen shed.

AN INVESTIGATION OF GEOTROPIC RESPONSE IN POLLEN GERMINATION

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Geotropic responses are well known in roots and stems of plants. A review of the literature indicates little available information on tropisms in pollen germination. Flowers, however, grow in horizontal vertical and inverted positions.

Factors known to be involved in plant and stem geotropisms such as gravity, magnetism, hormones, statoliths and calcium gradients were studied in pollen germination. Germ pores of the pollen grains and the direction of pollen growth were also taken into account.

The direction of pollen tube growth in all investigations was found not to be statistically related to the factors studied.

The research indicates that geotropic responses are not involved in pollen tube growth. The lack of geotropic response in pollen growth indicates that pollination of plants may not be effected during space travel.

THE EFFECT OF SELENIUM ON THE UPTAKE OF MERCURY IN PISUM SATIVUM

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Throughout the years, mercury has been used for a variety of products including pesticides, fungicides, and other agricultural chemicals. Since mercury is non-biodegradable, it remains in our environment and will pass through all levels of the food chain. Selenium is another element that is toxic to animals, however, it is also an essential trace element. In certain parts of the United States, there are plants that accumulate high quantities of selenium. This can prove dangerous to both grazing animals and man. Although there has been great concern over present day environmental threats, people often forget the hazards of older problems.

For the past five years, I have conducted research dealing with different aspects of mercury in plants and man. In my current research, I observed the combined effects of mercury and selenium in pea plants. I hypothesized that the presence of selenium would curb the presence of mercury in the plants. Selenium frequently replaces sulfur in biological situations. The sulfhydryl unit, for example, can be transformed into the selenohydryl unit. Since mercury has an affinity for sulfhydryl groups, it is likely that selenohydryl groups attract mercury and prevent entry into the plants.

Pea plants were watered with either mercury solutions, selenium solutions, or a combination of both. The solutions were concentrated at 20 ppm, 60 ppm, and 100 ppm of the elements by adding mercury dichloride or sodium selenate to distilled water. After a few weeks, the plants were removed from the soil and analyzed for mercury (using Flameless Atomic Absorption) and selenium (using Spectrofluorometer). The data collected proved that my hypothesis was correct, however, further research will be conducted to investigate mercury and selenium reactions.

#Second Award - U.S. Air Force
Fourth Award - ISEF/Botany

A STUDY OF THE EFFECTS OF CHEMICAL FERTILIZERS AND A GROWTH HORMONE ON THE CELLULAR DEVELOPMENT AND DNA ACTIVITY IN MONOCOTS AND DICOTS

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This experiment is to determine the effects of chemical fertilizers and a growth hormone on the cellular development and DNA (deoxyribonucleic acid) activity in monocots and dicots.

This will be determined by treating various groups of orchid and chrysanthemum plants with four different treatments. These treatments are 30-10-10 fertilizer, 10-10-10 fertilizer, 10-30-20 fertilizer and the growth hormone, Gibberellic Acid.

This experiment is based on a study demonstrating the effects of the various treatments on the cellular structure of these plants.

From the microscope photographs I have taken, I can conclude that the different treatments affected the cells in various ways.

Fertilizers increased the size of the individual cells; whereas, the growth hormone, Gibberellic Acid, increased cellular reproduction.

Although the effects of these treatments were observed in both orchids/monocots and chrysanthemums/dicots, the treatments affected the chrysanthemums/dicots to a greater degree due to the more rapid growth processes of the chrysanthemum members of the dicotyledon sub-class.

THE SYSTEMIC RESPONSE OF ROMANO BUSH BEANS TO PRESOAKING SOLUTIONS

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PURPOSE: Presoaking bean seeds results in better germination. In all research, no mention is made of soaking in anything but water. My intent was to determine the systemic response of Romano Bush Beans to a variety of prosoaking solutions of varying pH values.
HYPOTHESIS: In my previous research on the effects of acid rain on germination, higher acidic exposure resulted in greater germination. Based on that finding, I expected seeds presoaked in low pH solutions to have better germination, growth, development, and production.
METHOD: I exposed 75 seeds to each presoaking solution, and one group of 75 control seeds had no exposure. The 11 groups presoaked for 12 hours. From each group, 40 seeds were randomly selected and planted. Seed appearance, germination, leaf development, growth, and harvest were observed and recorded. Results were compared with the pH of the solution.
RESULTS: Coffee and Tea produced the greatest harvest, but were not highly acidic. Vinegar and Lemon Juice, the most acidic, had the lowest rate of production, but produced the largest beans. Saccharin caused deformities in plant and leaf structure. Pop, which was highly acidic, was third greatest in production.
CONCLUSION: Presoaking solutions affect growth, development, and production of beans, but pH is not the only factor involved. Nutrients, stimulants, or inhibitors seemed to be present in many of the solutions, and further research is necessary to determine their effects under various exposure conditions. Increased production based on presoaking solutions is as important to the backyard gardiner as it is to the large scale farmer, and research can determine which solution is best.

EXPLORING THE PHYSICAL, CHEMICAL, AND MICROBIOLOGICAL QUALITIES OF DEAD WOOD.

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The decomposition speed of wood, the nutrient elements cycling and changes in wood structure via wood decay were studied in five forest types. That means five different environments and six wood types envolved. The critical difference is found in the waterways systems. Vessels on Dacryodes excelsa, Euterpe globosa and Cyrilla racemifora. Tracheids on Casuarina equisetifolia, Abies alba and Cyathea arborea.

The wood decomposition determines the speed in which nutrients and biomass are recycled in the forest to support the ecological cycles. This kind of research will be very important to the woody industries, because they don't give attention to the wood resistance after decaying. They don't observe the process on its natural environment. The natural tendences suggest that the decomposition speed of any organic material increases as the decomposition process advance. The same tendence is applied to the nutrients concentrations. My results break this rules or tendences.

In a three year period several field and laboratory experiments were carried out. Also scientific instruments were constructed. All field works were conducted at The Caribbean National Forest (El Yunque) and Piñones Forest. The forest subtypes at El Yunque are: Palm Forest, Tabonuco Forest, Colorado Forest and also an Abies alba Plantation. The forest subtype at Piñones is dominated by Casuarina. 50 square meters plots were located at each forest subtype. Environmental parameters, biomass production, dead wood classification by decomposition stage, position, species, etc. were analyzed.

The nutrients present through the different phases of the decomposition process were anallitically measured (N, K, Mg, Ca, Na, P, and ash).

*XANTHAN GUM'S ENHANCEMENT OF CITRUS CANKER AND DIEFFENBACHIA LEAF SPOT

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Citrus canker, caused by Xanthomonas campestris pv. citri, is one of the most economically devastating diseases of citrus. Xanthomonas bacteria are coated with a gum comprised of exocellular polysaccharides. This coating, extracted as xanthan gum, may be involved in the actual microbe:host-cell interactions. A study was initiated to determine the influence of xanthan gum on the growth and development of citrus canker (Xcc) as compared to X. campestris pv. dieffenbachiae (Xd), a bacterium that causes leaf spot in dieffenbachia plants.

Xcc and Xd growth rates were compared in different pH and xanthan gum levels, and scanning electron microscope techniques were used to determine bacterial growth on cotton, citrus albedo, leaves, and root hairs treated with solutions of Xcc and/or xanthan gum. Tests also showed the xanthan gum stimulated canker symptomatology by typically nonpathogenic pathovars; lesions developed in citrus injected with Xd suspended in xanthan gum. Tests were also conducted to determine in vivo enhancement of Xcc and Xd by xanthan gum at 10, 100, and 1000 ppm in Swingle grapefruit and dieffenbachia. At the end of 21 day readings, Xcc and Xd exhibited a ten-fold increase in colony-forming units in leaves inoculated with the xanthan gum-amended bacterial suspensions. Spray inoculation trials produced a seven-fold increase in lesion formation with the Xcc plus gum combination.

It may be concluded that xanthan gum enhances citrus canker and dieffenbachia leaf spot growth. Further research is planned to explore the interactions between xanthomonad pathogens and hosts.

*London International Youth Science Fortnight Trip - U.S. Navy
First Award - American Phytopathological Society
Second Award - ISEF/Botany

*ANTIBIOTIC RESISTANCE OF DUNALIELLA SALINA AND DUNALIELLA PARVA

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Dunaliella salina and Dunaliella parva, two species of wall-less, unicellular, green, marine algae, have been tested for their ability to withstand various antibiotics. Both species showed an impressive resistance to kanamycin, streptomycin, and many other aminoglucosides, which is a group of antibiotics most widely used in genetic transformation and selection schemes. Further investigations revealed that the algae do not resist these antibiotics by utilizing typical degradation enzymes. This suggested that D. salina and D. parva have a membrane-level regulatory system which is significantly different from that of a typical green alga. Also, the results revealed that the algae are slightly sensitive to chloramphenicol and some other antibiotics. Although Dunaliella is considered to be a good subject for algal genetic engineering, the ability of the alga to withstand some aminoglucosides could interfere with the antibiotic selection procedure. However, if proper antibiotics, such as chloramphenicol and cycloheximide are used, effective selection is possible. Chloramphenicol resistance gene is widely used in transformation and selection of many bacterial species. Therefore, a vector which contains a useful gene coupled with a chloramphenicol resistance gene may be used for effective transformation and selection of Dunaliella species.

*Third Award - ISEF/Botany

*PLANTS AND ULTRAVIOLET RADIATION

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It is believed by some that the ozone layer, which filters harmful ultraviolet radiation from the sun, is beginning to deteriorate. If the ozone layer did deteriorate to where ultraviolet "C" would hit the earth, it would probably have a devastating effect on all living organisms. The purpose of this research was to determine the effects of ultraviolet "C" radiation in the 253.7 nm. wavelength on developing plants. Germicidal lamps were used to produce the ultraviolet rays, and calculations were made to determine the amount of irradiance hitting the plants.

Sixty Phaseolus vulgaris (bean) plants were placed under 30, 60, and 90 minute levels of radiation (20 plants each) every day for 14 days. There were also 20 control plants used. Because these levels of radiation actually killed all 60 plants within the 14 days, 9 lower levels of radiation (1,3,5,7,9,11,15,20 and 25) were used on 1000 germinating Phaseolus vulgaris (bean), 1000 germinating Beta vulgaris (beet) 1000 Zea mays (corn) and 1000 Triticum aestum (wheat) seeds for 5 days and 200 or each of the same type of young plants were also tested at these levels for 14 days.

The results of the test indicate that ultraviolet "C", when used on developing plants and on germinating seeds, slowed down the growth and germination rates and actually killed the plants used with the higher levels of radiation in the 14 day period.

*Fourth Award - ISEF/Botany

THE USE OF A. TUMEFACIENS IN THE STUDY OF GRAVITROPISM

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The objective of this project is to investigate how the chemical make-up of crown gall cancer tumors affects the process of gravitropism or geotropism, which is a plant's response to gravity.

To determine if the chemical composition of crown gall tumors, which are induced into plants by Agrobacterium tumefaciens, can affect the process of geotropism in normal Helianthus annuus (sunflower plants), tumors from cancer plants were ground into solution and filtered. The chemical solution was then separated using the process of electrophoresis. The separation experiments lasted 20, 30, 60, 90, or 120 minutes. After the separation was completed, a center strip of the gel that the chemicals separated into was removed and cut into four blocks. The blocks were placed on healthy seedlings that were turned horizontally so the effect of geotropism could be observed. Time lapse photography, that was controlled by a computer, was used to record the effect of the blocks on the plants.

The experiments indicated that geotropism is most likely controlled by a synergistic relationship between two hormones: an auxin--indoleacetic acid or IAA--and cytokinin. It is believed that cytokinin is responsible for the production of cellular auxin. Thus, cytokinin is thought to play a more significant role in the controling of geotropism than what previous studies have seemed to indicate.

* A STUDY OF INDUCED ELECTRICAL CURRENT ON MELOIDOGYNE AND AGROBACTERIUM

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Each year, the United States alone, loses billions of dollars due to parasitic nematodes that infect plants. The loss of crops due to nematodes is one of the most crucial agricultural problems today. Meloidogyne (root-knot nematode) is thought to be one of the major culprits causing the damage. Control of this organism is generally accomplished by the application of nematicides, but these cause biological and environmental damage as well as the possibility of human pesticide poisoning. The results found in this research provide an alternative and safe method of controlling and preventing this plant pest.

This study was conducted to determine whether or not the application of direct current can be used as a means of controlling parasitic nematodes. The agricultural application from this research can be applied to reduce the cost of damage done by plant parasitic nematodes, the cost of treatment to vegetation with pesticides, the cost of treatment to people due to human pesticide poisonings, and the environmental damage done to our priceless environment.

Previous studies by this researcher have shown that electrical current is an effective means of controlling other plant diseases such as plant cancer caused by Agrobacterium.

*Fourth Award - ISEF/Botany

PINE GROWTH AS AFFECTED BY FERTILIZER AND HERBICIDE

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To test whether controlling weed competition can enhance the effectiveness of fertilization, newly planted slash pine (Pinus elliottii) seedlings were given the following treatments: F1H1 (Control), F2H1 (fertilization only), F1H2 (herbicide only), and F2H2 (combination of F2H1 and F1H2). Five months after treatment light meter readings were taken in each plot and weeds were harvested for biomass measurement and nutrient analysis. Eight months following treatment, tree heights were measured and selected seedlings were cut for biomass determination and nutrient analysis. Biomass of the trees left in the plots was estimated by a regression equation based on the heights and dry weights of the sampled seedlings.

Results showed that without any treatment (F1H1), the pine trees gained only 18 kg/ha of dry weight while those receiving the F2H1, F1H2, and F2H2 treatments respectively gained 37, 73, and 149 kg/ha of dry weight. Without herbicide treatment, weeds outweighed the trees by 180 to 18 kg/ha without fertilization (F1H1), and 465 to 37 kg/ha with DAP treatment (F2H1). With herbicide, dry weight gained shifted in favor of the trees; 72 to 34 kg/ha without fertilization (F1H2) and 149 to 39 kg/ha with fertilization (F2H2). Nitrogen (N) and phosphorus (P) uptake closely followed the pattern of weed and tree biomass accumulation, indicating the importance of these nutrients in tree as well as weed growth. Based on the light meter readings, light supply was severely reduced by the weeds stimulated by DAP treatment (F2H1).

The results of this study strongly demonstrate that DAP fertilization is effective provided that weed competition is being controlled. ###

* A FOUR YEAR STUDY OF THE PHYSICAL AND CHEMICAL FACTORS THAT ALTER THE GROWTH AND DIFFERENTIATION OF *LYCOPERSICON ESCULENTUM* AND *DAUCUS CAROTA* WHEN GROWN AS A TISSUE CULTURE

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The first three phases of my research dealt with the effects of various factors upon the growth and differentiation of the tomato. Factors tested were oxygenation of the media, the use of different regions of the root, and the addition of the hormones, auxins and cytokinins, to the media. Electrostatic effects on cell differentiation have been investigated recently in various cytological experimentations. The purpose of the next phase of my research was to find the effects of electrostatics at various exposure times on carrot tissue cultures. The results indicated that the electrostatic exposure of the tissue had an adverse effect upon the plastid number within the cell as well as prompting the deterioration of the cell wall. Thirteen percent of the tissues charged for only one second did start to develop callus a week before the controls did. There has been much research conducted involving the effects of electromagnetics on whole plant systems, while little has been done involving the application of electromagnetics to plant tissue cultures. Carrot cell cultures were exposed to either .65 or 2.5 amperes for either 1, 5, 10, 15, or 30 minutes. A proportion of the tissue cultures were viewed microscopically and the effects of the electromagnetism on individual cells was determined. The higher the exposure time and concentration of the charge the more detrimental it was to cell development. However, electromagnetism was found to increase the rate of cell division. The most beneficial charge, the one inducing the most rapid rate of cell division, was determined to be .65 amperes for an exposure time of one minute.

*Third Award - ISEF/Botany

* STUDIES WITH POSTHARVEST PATHOGENS OF TOMATO FRUIT

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Fungal infections constitute the majority of diseases found in tomato fruits. Research conducted on tomato pathogens explored interactions between invading fungi, host tomato fruit, and the surrounding environment. Possible antagonists to these pathogens were also investigated.

Studies were made on the effects that temperature has on the growth of *Aspergillus niger*, a tomato fungal pathogen, *in vivo*. Four sets of tomato fruits were puncture inoculated with *A. niger* spores and incubated at 20 C, 25 C, 30 C, and 35 C. Results showed that the lower the temperature, the greater the suppression of fungal growth.

Biocontrol agents were also explored as antifungal alternatives to chemical treatments. Research focused on testing unidentified bacterial strains as potential biocontrol agents of *A. niger* both *in vitro* and *in vivo*. The results of fruit inoculations showed that the bacteria actually increased the rate of fruit decay over the fungus alone. No antagonism was found in the *in vitro* plating experiments.

Growth rates of *A. niger* were investigated on extracted cell walls of tomato fruit (mature green and red ripe) and control glucose medium. Results revealed that mature green cell walls could inhibit *A. niger* growth by up to 50%.

*Fourth Award - American Phytopathological Society

* GROWTH INHIBITION BY EXOGENOUS L-[1-^{13}C] PROLINE AND ITS METABOLISM IN *DISTICHLIS SPICATA* SUSPENSION CULTURES

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Because halophytes have a natural tolerance to salt, this trait may be genetically transferred to cash-crop glycophytes. The basis for halophytic tolerance to salt is not fully understood, however. Two osmolytes accumulated by halophytes such as the graminoid saltgrass *Distichlis spicata* are glycine-betaine and proline, but the role of proline accumulation has been subject to debate. This study of the effects of exogenous proline on the growth of *D. spicata* is an examination of the metabolism of exogenous L-[1-^{13}C] proline by analysis of suspension extracts with ^{13}C NMR spectroscopy in order to further evaluate the role of proline accumulation in adaptation to salt stress.

The growth of *D. spicata* suspension cultures on 0 mM NaCl medium was inhibited 54% by 2 mM proline. On 260 mM NaCl medium, 10 mM proline inhibited growth by 22%. Carbon-13 NMR and ninhydrin analysis revealed that removal of 85 to 92% of 10 mM proline had occurred within 72 h from all tested media. On 0 mM NaCl, proline reached a maximum of 51.5 uMoles/g FW compared to 1.9 uMoles/g FW in suspensions not grown on proline. On 260 mM NaCl and proline, cellular proline reached 59-65 uMoles/g FW compared with 03-40 uMoles/g FW in controls. The ^{13}C-label in the C_1 of proline was either retained in proline or disappeared, presumably released as carbon dioxide, by metabolism through the TCA cycle. Excess proline was the molecule which inhibited suspension growth, as only ^{13}C-labeled NMR peaks were observed in lieu of proline metabolites.

*First Award - U.S. Air Force
First Award - U.S. Army
Fourth Award - ISEF/Botany

LEAFY SPURGE CONTROL: A TWO YEAR STUDY

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A purpose of this project was to continue to test ways of harming or killing leafy spurge (*Euphorbia esula*). Another purpose was to determine if there is a difference in allelopathic properties, toward leafy spurge, between *Antennaria neglecta* and *Antennaria microphylla*.

Three different experiments were conducted throughout this project: Experiment 1 was to test if *Antennaria neglecta* had any effect on leafy spurge. This was done by planting leafy spurge root segments with *neglecta* plants, and recording the growth of the leafy spurge every day. Experiment 2 was designed to test if the pH of the soil effected leafy spurge growth. Twenty pots were planted with leafy spurge root segments and they were watered with solutions of either pH 7, 6, 3.9, or 2. The growth was recorded each day. Experiment 3 was designed to test if extracts of both species of *Antennaria* had any effect on leafy spurge root elongation. Each species was extracted with four solvents. The solvent extracts were dried and then dissolved in methanol or hexanes. The solvent extracts were then put in agar and germinated leafy spurge seeds were grown in the agar for three days.

The results from this project indicated that the pH of the soil had no effect on leafy spurge, but that the ethyl ether extract of both *Antennaria* species and the methanol extract of *Antennaria neglecta* had some effect on leafy spurge root growth.

THE EFFECTS OF ENDOPHYTE INFECTED FESCUE ON BEEF PRODUCTION IN TRIGG COUNTY, KENTUCKY

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Endophyte fungus in fescue has been directly linked with summer toxicosis in beef cattle, resulting in losses of millions of dollars of income for American farmers. Fescue pastures in Trigg County, Kentucky were sampled and the percentage of endophyte infection determined through microscopic examination. Some plants from each sample were maintained in a greenhouse and growth of the endophyte studied. Beef producers were surveyed to obtain production data. A comparison of the percentage of endophyte infection present in the fescue and the production data was made. The study, the first to be done on Trigg County farms, showed that the percentage of endophyte increases as the plant matures, and that endophyte-infected fescue lessens the average daily gain and weaning weight in beef cattle, thus, reducing annual income for Trigg County beef farmers.

A Study of the Cold-Hardiness of Grasses Used in Florida Phase 2

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The beginning of 1977 meant a shock to the lawns of many homeowners, as the temperatures literally went wild. The high on January 15 was 56° F., and the low four days later, on January 19, was 11° F. These wild temperature swings are extremely common in the Florida Panhandle. Every year, homeowners complain about the death of their grass. They have all begun to wonder, "Is it possible to prevent this grass from dying? Can the cold-hardines of grasses be improved?"

For the purposes of this experiment, I chose to use the three grasses which are most commonly used in Florida Panhandle lawns: Pursley's Seville St. Augustine, Raleigh St. Augustine, and Common Centipede. Italian ryegrass was also used to overseed the grasses in some of the experiments.

Based on the results of a series of experiments, it can be concluded that there are many ways to improve the cold-hardiness of grasses used in the Florida Panhandle.

PREVENTING THE BROWNING OF APPLE TISSUES

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The tissues of fruits and vegetables turn brown when they are cut or damaged. The hypothesis was that the browning of fruit tissues could be prevented by treatment with ascorbic acid and other antioxidants. Apple tissues were treated with ascorbic acid, its derivatives, and other antioxidants to determine if the browning could be prevented.

It was found that ascorbic acid at concentrations of 1% or higher were effective in preventing browning. L-Ascorbic Acid 6-Palmitate and ascorbate-2-phosphate (2 derivatives of ascorbic acid) were effective in preventing browning at concentrations as low as 0.2%. The hypothesis was correct in that the browning process of fruit tissues can be prevented by ascorbic acid and other antioxidants. A combination of 0.1% concentration ascorbic acid and 0.5% concentration citric acid was found to be the best in preventing browning.

#First Award - ISEF/Botany

*THE EFFECTS OF A 5KHZ TONE GENERATED AT 100 & 400 BEATS/MINUTE AT 100 DB ON THE GERMINATION & GROWTH OF CALDWELL WINTER WHEAT.

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PURPOSE: To determine if a pulsated tone of 100 & 400 beats/min at 5 KHz, at 100 dB, has any effect on the germination & growth of Caldwell Winter Wheat as phase V of an ongoing investigation of the effects of sound on plants.
PROCEDURES: A tone interrupter was engineered. A total of 120 seeds were planted hydroponicly per experiment. Each sound proof box contained 40 seeds. Group I seeds were exposed to 400 beats/min, Group II were exposed to 100 beats/min, & Group III were exposed to silence. The experiment was performed 3 times, rotating the soundproof cabinets.
RESULTS: Using X^2, the seeds preferred to germinate in silence to 100 beats(X^2 =25.87) & 400 beats(X^2 =17.67) in 12 hours. There was no statistical difference at 24 hours. Using Rank-Sum, the plants grew taller in silence than 400 beats(Z=4.04) or 100 beats (Z=5.32), & silence had more roots than 100(Z=3.22). There was no statistical difference between the number of roots in silence and 400 beats. Silence roots were heavier than 100 beats(14.5%) or 400 beats(12.7%), & silence tops were heavier than 100 beats(44%) or 400 beats(5.9%).
CONCLUSION: 100 beats/min retards growth significantly when compared to silence. 400 beats/min retards growth, but not quite as much.

*First Award - Eastman Kodak Company
Third Award - ISEF/Botany

THE EFFECTS OF SEVIN INSECTICIDE ON SELECTED VEGETABLES

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The purpose was to determine the effects of Sevin Brand 50 Wettable Carbaryl insecticide on the germination and growth of selected vegetables. The selected vegetables were bushbean, cabbage, carrot, corn, cucumber, and turnip. Spectrophotometric tests were used to determine the dissipation rate of the Sevin and to investigate its soil depth profile. The project consisted of two main phases. In the first phase, 360 seeds were germinated and another 360 seeds were grown with four different concentrations. The concentrations were 0 g/L(control), 1 g/L, 2 g/L, and 4 g/L. The factors which were examined were plant height, germination time, number of plants which grew, average number of leaves, leaf color, soil pH, and the seed viability. Statistical tests were used to determine whetherthe differences in plant height were significant. In the second phase, the dissipation rate and a Sevin soil depth profile were investigated using the Beckman DU-7 Spectrophotometer. The experimenter concluded that Sevin Brand 50 Wettable Carbaryl insecticide was a major growth inhibitor to the selected vegetables. There was a marked variation in leaf color which ranged from green (control group) to yellow (4 grams per liter). Also, there was a reduction in the number of leaves per plant as the concentration of the Sevin increased. Sevin has a very slow dissipation rate. This insecticide's highest concentrations were found at the same depth as the majority of the plants' roots.

*ANALYSIS AND CONTROL OF DISEASES ON SUNFLOWERS (*HELIANTHUS ANNUUS* L.) WITH NUTRITIVE INTERACTIONS

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I am investigating the types and severity of diseases on sunflowers in West Central North Dakota, the impact of these diseases on the plant's nutrition, and the interactions between the pathogens and the fertilizer salt forms used to supply the necessary nutrients to the plants.

In 1986 and 1987, foliar percent necrosis ratings were obtained from field plots containing 30, 50, 60, and 90 pounds of nitrogen per acre and a total of 11 cultivars. Samples were collected and plated, and fungal isolations were made. Pathogenicity tests, hydroponic inoculations, and leaf disk inoculations were performed. Statistical differences were detected with ANOVA.

The major pathogenic organisms invading the fields include *Alternaria helianthi*, *A. zinniae*, *A. alternata*, *Phoma*, *Ascochyta*, *Septoria*, *Fusarium*, *Helminthosporium sativum*, and an Ascomycete. These fungi induced N, Mg, and Fe deficiencies and a K toxicity. The lowest necrosis ratings were detected with 60 lb/A of N.

In conclusion, *Alternaria* and *Fusarium* appear to dramatically alter the translocation of N in sunflowers. By supplying the majority of the N, K, and Ca required for proper growth in the nitrate form, the P in the phosphate form, and Mg and Fe in the sulphate form, the severity of the fungal effects appears to be diminished. The fungal suppressant nutrient solution that I developed possesses the potential for increasing the yield and nutritional quality of the achenes through the maintenance of a high level of photosynthetic efficiency and decreasing the rate of senescence. Thus, by continuing my research, I hope to prove that the utilization of fungicides can be avoided in some cases.

*First Award - American Statistical Association
First Award - U.S. Navy
Third Award - American Phytopathological Society
Third Award - ISEF/Botany

HOW CAN THE SCREEN HOUSE HELP GUAM'S FARMERS

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Guam is located in a tropical zone. Guam's farmers must deal with many difficulties such as typhoons, quick fluctuations between sunny and rainy weather, insects, and extreme heat. The purpose of my project is to introduce a new, economical farming technique, the screen house, to the farmers on Guam.

With a shading material covering the top of the screen house, the temperature inside can be lowered; the soil's moisture is retained for a longer period; insects are minimized; and the climate is more controllable.

I constructed three models of the screen house. Each was covered with a different type of screening material - a screen net, a plastic screen and a black-silver screen. All three were also covered with the same type of shading material. I measured the temperature inside and outside of the models on five different days. The screen house covered by the screen net had the lowest temperature. Then I planted the same amount of *pai-tsai* (a type of Chinese cabbage) in each of the three models and outside the screen houses. After forty days, the screen net model had more products.

The screen net model also displayed better wind resistance, so that it would be less damaged by a tropical storm or a typhoon. I concluded that the screen net model is best suited for Guam's weather.

The screen house can help Guam to be a more productive place.

* THE EFFECT OF SURFACTANTS ON PISUM SATIVUM

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In this investigation, the hypothesis stated that reduced surface tension water would affect the water absorption and retention rate of the soil and enhance the absorption of water and nutrients by the plant roots. The experiment was designed to test the hypothesis.

First, the surface tension reduction capabilities of three surfactants: sulfated glycerol trioleate, ethoxylated fluoroalcohol, and ethoxylated tridecyl alcohol, were measured using the capillary rise method. The critical micelle concentration of each material was established.

Next, the effect of surfactants on water absorption & retention was measured by treating pots of soil with the various surfactants and measuring the amount of water absorbed & retained over a period of time after the pots were placed in water for 30 seconds. According to a student-t test performed on the data from this phase, the surfactants had a significant beneficial effect on the rate of absorption & retention.

The plants to be used, P. Sativum, were divided into 4 groups: one group for each surfactant & a control. Fifty plants (started from seed) were used in each group. The period of study has been in progress for approximately 4 months, with photographic records & measurements being made weekly. Unfortunately, the DA-6 proved to be toxic to the plants. However, the results of the student-t test have indicated a significant increase in growth rate in the sulfated GTO and Fluowet OT groups with over a 99% level of confidence.

*Fourth Award - ISEF/Botany

"CLUTCH SIZE" IN SUNFLOWERS, HELIANTHUS ANNUUS L.

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Numerous studies have shown that the clutch or litter size in animals is related to the supply of available food. The purpose of this research was to determine if sunflowers, Helianthus annuus L., have an optimum clutch size as determined by certain environmental factors. Sunflower heads, containing flowers, were collected from populations located in three different sites having different elevations and lengths of growing seasons. The number and weight of seed per head was determined for individuals and populations. The percentage of seeds showing evidence of being damaged or eaten by insects was also determined. Results have shown that the number and weight of seed per head varies significantly within individuals and among populations at different elevations having different lengths of growing seasons. The variations within individuals may be due to genetic variations or time of flower set. Variations among populations at different elevations are most likely due to the varying lengths of the growing season. This in combination with other factors such as grazing pressure by insects on seeds appears to serve as selective forces influencing the clutch size in sunflowers. A model is proposed showing that clutch size is the result of environmental factors, such as length of growing season and altitude, acting on the genetic makeup of each population. This results in the selection of an optimum range of seed number and weight, therefore increasing the chance of survival of Helianthus annuus L. in a given habitat.

WHAT IS THE EFFECT OF ELECTRICITY ON RAPHANUS SATIVUS?

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This experiment determined the effects of small amounts of electricity on radish plants.

Phases I and II tested for best voltage and polarity. Results were that plants given -3.0Vdc had the best growth.

In Phase III, I replaced soil and tap water with vermiculite and de-ionized, distilled water in order to remove all possible externally-induced ionization. Commercial plant food and a plant light were used to provide controlled nutrients and sunlight.

After fitting copper grids in the bottom and top of each pot, including the controls, I connected one-third of the pots with 3.0Vdc from two "C" batteries. The positive (+) anode was connected to the top grid and labeled "+". Batteries attached to the second one-third group of pots were reversed and labeled "-". The last one-third (controls) had no voltage applied to them.

Phase III results: All plants, which were compared through direct observation, data comparisons, and CHI square statistical analysis, indicated the -3.0Vdc plants to be the healthiest and quickest growing. Conclusion: the "negative" polarization stimulated the hormone auxin which provides the regulation of growth through its influence on cell enlargement and division. This caused the cells to enlarge and divide faster than non-stimulated cells. However, the "positive" polarity inhibited the auxins, resulting in the retardation of the plant's development.

FACTORS AFFECTING GROWTH OF CROWN GALL CAUSED BY A. TUMEFACIENS

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A three year study was conducted of factors affecting the growth of crown gall (plant cancer) on Helianthus, caused by Agrobacterium tumefaciens. The first year study consisted of the use of aloe vera against crown gall. The second year study examined the effectiveness of streptomycin, colchicine, and Vitamin B_1 on the crown gall disease. Third year involved a relatively new biological control agent known as Agrobacterium radiobacter, strain K-84. All factors in year one and two with the exception of Vitamin B_1 indicated different degrees of effectiveness in controlling crown gall. Results in year one and two were achieved under closely monitored and controlled conditions. Third year study was conducted under natural field conditions. Agrobacterium radiobacter's effectiveness was challenged when selected fertilizers were used as food supplements for the plants. Fertilizers used were 20-20-20, 13-13-13, 8-8-8, phosphate, and potash. Primary results indicated a working relationship between all fertilizers and Agrobacterium radiobacter, with the exception of phosphate. Phosphate inhibited Agrobacterium radiobacter, therefore not allowing it to be effective. Final results indicated that all fertilizers allowed Agrobacterium radiobacter to be effective for a limited period of time. After approximately 40-45 days tumors appeared on all plants.

#Second Award - ISEF/Botany

COMMERCIALIZATION OF OUR MARINE RESOURCES. PHASES I & II.

TOUZON-AGUILERA, JOSE ANGEL
DE LA SALLE HIGH SCHOOL
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After I proved the effectiveness of the sinker system as one of artificial preservation of some agarofits (of the group of *Rhodophyta*) I planned to enlarge the objectives of the system with new agarofits species and with carrageenan producers species (gel, that, as the same as agar, have a great demand because of its several uses). This species were recolected along the coasts of Puerto Rico and they were planted , using the system, in fish tanks (trying to make an adecuate ecosystem for their communal development), for a five week period where they were daily observed. After this period I obtained the results. The sinker system resulted to be a great one for the cultive of the new species. Then I proceeded to extract the corresponding gel to each specie, obtaining excellent yield per cents. One of the principal objectives of this proyect is the industrialization of the agarofits in Puerto Rico, using the sinker system to prevent species' extinction. I mentioned agarofits because they were the most that I have proved their adaptability to the system. There are some studies where they certify the gel that is extracted of the species that grow along the coasts of the Island as one of very good quality. With this we have the first step to get that industry. By the results of these studies I'm analizing the economic proyections that can serve as a base for a future industry of phycocolloids in Puerto Rico.

PLANT AND SEED RESPONSE TO INCREASED GRAVITIONAL FIELDS

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Goals of this experiment were to determine in what ways gravity affects the growth of plants: how marigolds and corn geotropically respond to increased gravitational forces; how germination time is affected by increased G-forces; what effects increased G-forces have on seed development and a second generation of plants. The experiment was conducted in two stages. In stage one, both corn and marigolds were grown on a rotating turntable capable of simulating up to six G-forces. The plants were constantly subjected to these increased gravitational fields and observed. Before stage one ended, seeds were taken from the experimental and control marigolds. In stage two, these seeds were planted in a normal gravitational environment and observed for any differences in growth between the experimental group, the control group from stage one, and an additional control group grown from a new set of seeds. In stage one, both corn and marigolds exhibited definite geotropic responses. The experimental marigolds did not grow as large or as leafy as those on the control. The plants on the turntable germinated an average of two days earlier than those on the control. In stage two, the marigolds grown from the experimental seeds germinated up to four days earlier than those grown in the control environment. The following conclusions were drawn: corn and marigold plants both grow geotropically at up to six G-forces; marigold growth is stunted under high gravitational forces; both marigold and corn plants germinate faster when G-forces are increased; marigold plants carry over germination responses to a second generation.

STUDY OF THE CHEMICAL COMPONENTS, CHROMATOGRAPHY AND INHIBITORY PROPERTIES OF AMELIA AZEDARACH ON XANTHOMONAS VESICATORIA AND MYCENA CITRICOLOR

Acosta Torres, Reinaldo- Felipe Colón Diaz JHS Juana Diaz, P.R
D- 62 Urb Hnos. Santiago, Juana Diaz, P.R. 00665

This work pursues to investigate the antibiotic and antimicotic properties of the Melia azedarach plant over Xanthomonas vesicatoria and Mycena citricolor The first phase of this study deals with the collection of affected specimens in the culture stations in order to report the phitopathological affections of the following plants: Lycopersicon esculentum, Allium icepa, Ixoria coccina, Citrus limonea and Citrus sinensis. I then proceeded to accomplish the cultures to isolate the microbiotic with the help of a phitopathologist As the Gram Stain were carried out I found out that the bacteria (X vesicatoria) tinted positive and the yeast (M. citricolor) tinted negative giving base for its identification As the sensibility test with the leaf and the seed were accomplished extracts from both were used at 50% and 100% concentration. The best results were obtained with the seed on Xanthomonas and Mycena One hundred percent of the test accomplished presented inhibition zones and at a major concentration a major effectivity. In relation with the cromatographic study the following pigments were identified: fucoxantine chlorophyll A and chlorophyll B. The liquid and thin layer chromatographies revealed the presence of gases oils volatile compounds and alkaloids I finally indicate that Amelia azedarach can be used as a biological control in the treatment of phitopathological attacks

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IN VITRO TRANSFORMATION OF NICOTIANA TABACUM PROTOPLASTS BY CO-CULTURE WITH AGROBACTERIUM TUMEFACIENS

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Genetic engineering requires a procedure for introducing DNA into host cells followed by integration and gene expression. The purpose of this project was to transform Nicotiana tabacum protoplasts by coculture with Agrobacterium tumefaciens. The major obstacle to DNA uptake in plant cells is the cell wall but this can be eliminated by using plant protoplasts. The cells of Nicotiana tabacum were freed of their cell wall by enzymatic digestion with cellulase. The tumor-inducing bacteria, Agrobacterium tumefaciens, was chosen as a natural system for the induction of foreign DNA into the protoplasts. The DNA encodes the specific enzymes responsible for the formation of the amino-acid derivatives octopine and nopaline. The transformed cells acquired the ability to grow in the absence of phytohormones. The transformants were selected by their ability to divide and grow in tissue cultures without the addition of plant phytohormones. The detection of octopine and nopaline dehydrogenase enzymes activity was detected by the method of Otten, (1978). The presence of these enzymes can be considered a good marker for cells transformed by Agrobacterium tumefaciens. These results indicated that Agrobacterium tumefaciens was a reproducible method for the stable transformation of plant protoplasts and can be used for genetic engineering in higher plants.

STUDIES OF THE GENUS *LEPIANTHES*: BIOPHYSICAL AND BIOCHEMICAL-AIDED ISOLATION OF SPECIES

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The genus Lepianthes is one case of controversial taxonomy. Differences in morphology, as well as in habitat conditions, have posed interesting classification problems to classic botanical knowledge. The present study is an attempt to use several biophysical and biochemical methods as aids in the isolation of the species of the genus *Lepianthes*. The first areas in which this approach is to be implemented are water potential and enzyme activity. Investigations concerning absorption spectra and photosynthetic efficiency are also planned.

Individuals collected from several stations around the San Germán, P.R. area were first examined taxonomically, various environmental parameters and growth characteristics were recorded for each station. It was possible to identify three *Lepianthes*, two of them with clear morphological traits, *Lepianthes peltatum* and *Lepianthes umbelatum*. A third plant maintains a striking resemblance with the other two, but shows some difference in the degree of development and form of leaves.

Measurements using both the Gravimetric method and the Chardakov falling drop technique with different concentrations of a solution of dextrose, have shown a high water absorption rate to be a characteristic of the open leaved *Lepianthes*, while the close leaved *Lepianthes* shows a moderate intake of liquid. Specific histological differences in the mesophyll of the species may be consistent with this effect.

Lichen Acids as Bacteriostats

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The purpose of my research was to determine if lichen acids could be used to inhibit the growth of bacteria. Lichen acids are organic substances that are found on the surface of most lichen organisms, but their function or importance is relatively unknown. I began by isolating the acids. This was accomplished by washing the acids from the surface of the thallus with three drops of acetone. When the acetone evaporated, three drops of a glycerin-alcohol-analine solution were added to the residue that remained (after the acetone evaporated). Under a microscope, I found that the acids had been crystallized. The crystals were of various shapes and sizes (depending on the species used). With the help of Mason Hale's *Lichen Handbook*, the acids were identified. I chose to work with usnic acid and salacinic acid because of their large crystals. Filter-paper discs were soaked on the slides containing these two acids and placed on various bacteria cultures. Two controls were used: distilled water and the crystallizing solution. The cultures were placed back in the incubator and monitored over a 72 hour period; recording any observations every 24 hours. I found that the acids produced a bacteria-free zone against all Gram positive bacteria used in the experiment, but they were ineffective against Gram negative bacteria. The controls had no effect. In conclusion, my data seems to suggest that these organic acids may protect the lichen from bacteria in the environment and may also be of therapeutic value to man in the future.

WHAT ARE THE EFFECTS OF DIFFERENT LEVELS OF SALINITY ON THE GROWTH OF PHASEOLUS LIMENSIS PLANTS?

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There are many areas of the world which are infertile for growing crops because of the high salinity levels of the soil. Some crops are tolerant to a specific amount of salt so there must be a certain concentration of salt that overbears that plant's ability to repel it. The hypothesis was that the higher the level of concentration of salt used to water the plants, the weaker and less healthy they would grow. This was because the process of osmosis would most likely have taken place which would have caused the water to move out of the plant cells thus resulting in dehydration of the plants.

In the process of the experiment, five samples of phaseolus limensis seeds were planted in identical pots and set in ideal growing conditions until they began to sprout. Each sample was watered with a different concentration of sodium chloride- water solutions which were mixed by measuring out the exact quantities of sodium chloride (25 g., 15 g., 5 g., and 1 g.) . The samples were watered at least twice a week and a journal was kept on how the solutions were affecting each plant.

By analyzing the results, the hypothesis was correct. Different levels of salinity affect plants in the same way, but to different extents. The control and lower concentration samples grew quite nicely. They had many leaves and were quite sturdy while the plants watered with the higher concentration solutions started to become very droopy and began to die. This happened because osmosis took place as stated in the hypothesis.

* ALLELOPATHIC COMPOUNDS FROM CENTIPEDE GRASS

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Allelopathy involves a plant producing chemical compounds, and releasing them into the environment thereby inhibiting growth of neighboring plants. Vigor of cinnamon trees (Cinnamomum zeylenicum) was significantly affected when centipede grass (Eremochloa ophiuroides) served as the surrounding ground cover. It was hypothesized that E. ophiuroides produces allelopathic compounds that affect the growth of C. zeylenicum. In testing for the possible allelopathic effect, different types of experiments were used. Lettuce seeds (L. sativa) were used to test the allelopathic effect of E. ophiuroides. Potential allelopathic compounds from E. ophiuroides were separated by paper chromatography. A spectrophotometer was also used to help establish differences in absorption spectra of inhibitory and non-inhibitory chromatographed strips.

Inhibition of germination was demonstrated in both the pure and dialyzed extract of E. ophiuroides. Extracts have been semipurified by paper chromatography and preliminary spectrophotometric measurements suggest these compounds might be phenolic. Numerous allelopathic compounds are phenolic and absorbs in the ultraviolet range.

***Third Award - ISEF/Botany**

POSSIBLE HORMONAL INTERACTION OF TRIACONTANOL USED AT SEVERAL CONCENTRATION ON DIFFERENT PROPAGATION TECHNIQUES ON PLANTS

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Carr 361, Km. 361, San Germán, P.R. 00753

Triacontanol is a primary alcohol of 30 carbons. Identified by Stanley Ries in 1977 as a crystalline substance. This study attempts to determine the effects of this alcohol in the germination, development and growth of plants tested by different propagation techniques and the mechanical changes induced.

Five different species of plants were exposed to 13 different concentrations which ranged from 2.1876 x 10-4M to 2.1876 x 10-15M. Percent of germination, primary root length, coleoptile length are among the parameter studied during periods of five and ten days. Biomass and X-ray test were used to determine the mechanical changes in the plants exposed to the primary alcohol. Statistical and photographic analysis were done to help in the interpretation of the results.

In vivo tests were also conducted, here the seeds of Sorghum vulgare and Phaseolus vulgaris were morphologically studied considering several aspects of the plants seeded in glass chambers were exposed to triacontanol to determine the radical system area in its normal life cycle.

Another test performed was the study of the properties of triacontanol as an inducting agent of ornamental floration of the plant Zinnia shumbelina. An early induction of the floration and a higher number of flowers were obtained.

ACID HYDROPONICS ?

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This project was chosen because of my interest in acid rain. Acid rain can have both harmful and beneficial effects on plant life.
The title of my project is Acid Hydroponics? Hydroponics is a method of growing plants without soil. I used the hydroponic system to eliminate the variable, soil.
The problem I set out to solve is "What effect different pH levels of simulated acid rain water have on the growth rate, leaf coloration, leaf texture, and yield of Phaseolus vulgaris plants grown in a hydroponic environment over an eighty-six day period." The hypothesis made was that when the acid (in varied amounts) was added to each of the hydroponic systems, the nutrient powder would have a buffering affect on the acid and that some of the plants would grow better than others, while those having a lower pH level (higher acid add) would exhibit growth limitations.
To conduct this experiment, five hydroponic devices were built. Six Phaeolus vulgaris seeds were planted in each of the systems. A nutrient solution was made and 2 teaspoons were added per 1½ gallons of water. The plants were grown for a week with water containing nutrient solution. Every two weeks, the water was changed and a certain amount of acid was added.
Some plants grew very well; others did not. there were no major differences in leaf texture or coloration, and only one of the plants produced a bean.
I proved that acid rain can have beneficial, as well as harmful, effects on plant life. An ideal pH level was found.

THE EFFECTS OF SURFACTANTS AND WATER REPELLENTS ON CRACKING OF APPLE

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In cherry, apple, tomato, and citrus fruits, cracking of skin and fleshy tissues prior to harvest results in great economic loss to growers. Rapid deterioration of the fruit usually follows the exposure of the ruptured tissue to air. Damage of this kind is especially detrimental to apple growers who grow the Stayman Winesap variety in the Shenandoah Valley Region (one grower estimated losses of more than $.5 million in one year). Apples crack as a result of increased water uptake by the cuticle during the long rain periods in the period from July to October.

To demonstrate the nature of fruit cracking, surfactants were used to decrease the surface tension of water, thus promoting increased water uptake through the fruit cuticle. Anionic (GR 5) and nonionic (X-77,DuPont Wk) surfactants caused more water uptake and cracking in Stayman apple than the cationic surfactant solution (Downy) or water. Fruit treated with Vapor Guard, Scotchguard, or a wax emulsion reduced uptake of a nonionic surfactant solution but did not reduce fruit cracking.

Submersion of apples in a nonionic surfactant plus Methylene blue dye solution indicated that the primary sites of water uptake were the lenticles and injured areas of the fruit cuticle.

Pesticides used for control of insects and diseases frequently have surfactants added as inert ingredients to aid in uniform coating of the fruit and leaves when sprayed. The results of this project generate suspicion that certain pesticide sprays may promote water uptake and fruit cracking. Further studies would be required to determine if the type of surfactants used in pesticides promote cracking. The nonionic surfactant, X-77, is a typical surfactant used on fruit trees to promote uptake of plant growth regulators.

The Isolation of *Spinacea oleracea* Chloroplasts to study their Growth Potential Outside the Cell

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This experiment was a continuation of last year's science project which was the determination of the order of breakdown of photosynthesizing pigments in the fall and the speciation of conifers by their chromatograms. This year's experiment was an attempt to prove that chloroplasts can survive outside the plant cell. The theory is that chloroplasts were once free-living organisms that developed symbiotic relationships with larger heterotrophs, which evolved into plants.

Spinach chloroplasts were isolated and incubated on nutrient agar and agar media. This was done by grinding spinach leaves and then centrifuging the spinach solution once at low speed to remove the cell debris and nucleii, and once at high speed to isolate the chloroplasts. The isolated chloroplasts were then transfered to petri dishes and incubated at room temperature. *Cyanophora paradoxa*, *Rhodospirillum rubrum* and an unidentified contaminant bacteria were compared to the chloroplasts in structure, function, and growth. There was insufficient evidence to show that chloroplasts will live by themselves, but there was enough proof to conclude that when incubated with the contaminant bacteria, the chloroplasts survived for about two weeks. The chloroplasts would also survive with the *Cyanophora paradoxa*. Chloroplasts must still have some symbiotic abilities to be able to survive with a completely different cell.

Chloroplasts could be used as a growth accelerator for future food sources like algae if a way was found to grow the chloroplasts quickly and in large amounts.

CHEMISTRY

THE KINETICS OF THE SOLVOLYSIS OF BENZHYDRYL BROMIDE AS STUDIED BY NUCLEAR MAGNETIC RESONANCE AND CONDUCTIMETRY

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Benzhydryl bromide reacts with water to give benzhydryl alcohol, a hydronium ion, and a bromine ion. This reaction was studied in a 90% acetone / 10% water, by volume, solution. The NMR technique used for studding this reaction involved measuring the increase in hydronium ion concentration with respect to time. Because the rate of proton exchange between hydronium ions and water molecules is much greater than the time scale of the NMR, only a single resonance is observed for the hydrogens in both water and hydronium. The chemical shift of this peak being a weighted mean of the mole fraction of water hydrogens times the chemical shift of water hydrogens plus the mole fraction of hydronium ion hydrogens times the chemical shift of hydronium ion hydrogens.
$(\delta_{H_2O/H_3O^+} = X_{H_2O}\delta_{H_2O} + X_{H_3O^+}\delta_{H_3O^+})$
As the reaction proceeds the concentration of hydronium ion increases causing a downfield shift of the mean peak due to the considerable deshielding in the hydronium ion. By following the shift of this peak with time a rate constant could be calculated. As a check to the NMR technique, change in conductivity of solution with time was used to calculate a rate constant. Rate constants calculated from NMR data and rate constants calculated from conductivity data agreed within 5%.

#Second Award - ISEF/Chemistry
Honorable Mention - American Chemical Society

THE IMPORTANCE OF CONTROLS IN EXPERIMENTAL RESEARCH

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Acid rain is caused in large part by sulfur dioxide released during the burning of coal. It is very critical to our environment that sulfur dioxide emissions be reduced.

The original hypothesis of this project was that a magnetic field could improve the efficiency of a sulfur dioxide scrubber. First, sulfur was burned to obtain sulfur dioxide. The gas was then sent through a calcium oxide solution in a scrubber, and the magnetic field around a current-carrying coil of wire was used in an attempt to improve the efficiency of this scrubber.

Preliminary results indicated that efficiency was enhanced not only by the magnetic field but by the presence of the unenergized coil itself. This is clearly ridiculous. Although attempts had been made to control variables, something had definitely gone wrong.

The project then changed from being one of improving scrubber efficiency to an investigation of these misleading results. The uncontrolled variable was discovered within the sulfur dioxide generator; the problem was due to the sulfur being more powdered at times while being more consolidated at other times. The results of this investigation are being presented in an attempt to demonstrate to other young researchers the problems of jumping to conclusions too quickly.

#THE EFFECT OF ENERGY FIELDS ON THE FORMATION OF LIESEGANG RINGS

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When a drop of silver nitrate solution is placed on a glass slide containing a dilute solution of potassium chromate in gelatin, the resulting precipitate of silver chromate forms in concentric bands or rings around the drop. The periodic precipitation process known as Liesegang ring formation, named after its discoverer Raphael E. Liesegang, has aroused the curiosity of chemists for more than half a century. The objective of this project is to examine the kinetic and mathematical correlations of the Liesegang system, as well as the effects of energy fields on the structural formation of Liesegang rings. The results of this investigation will also be statistically analyzed to rule out chance as a factor.

In order to thoroughly understand the Liesegang system two major types of experiments were conducted within a time period of five years. The system was then analyzed in the area of kinetics and mathematics. Once an ideal model of the Liesegang ring system was established the effect of energy fields upon the system was then analyzed.

Qualitatively, it is evident that the formation of Liesegang Rings can be altered by the various experimental conditions applied. The rings grew largest in diameter with respect to time under the influence of the 700nm wavelength. The reason being that the visible spectrum especially the 700nm wavelength easily gives up an e- to the $[Cr_2O_4$-] ion, thus giving it greater kinetic energy to travel a greater distance within a smaller time interval.

#Fourth Award - ISEF/Chemistry
Honorable Mention - Eastman Kodak Company

PLATINUM ELECTRODES, IS THERE A SUBSTITUTE? A STEP CLOSER

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Today with shortages and pollution of fresh water supplies, it is necessary to find alternate economical water resources. Commercial scale electrodialysis reversal (EDR) processes for water desalination, water pollution control, municipal water purification and industrial processes require expensive platinum electrodes. The objective of this project was to evaluate conductive polymeric materials as alternatives for platinum electrodes. The hypotheses were that a recirculating EDR cell can be used to accurately evaluate electrode performance; and that carbon-filled ethylene vinyl acetate (EVA) sheeting can be used to replace platinum electrodes. Building on three previous years of research in ion migration, selective and nonselective electrodialysis membranes and conductive plastics, an accurate method for evaluating carbon-filled materials was developed. This method includes a means of monitoring half cell potentials, flow rates, pH, and current flow, parameters that indicate electrode performance. A laboratory electrodialysis fixture borrowed from the Ionics company in Watertown, MA was utilized for this project. Ionics' system was designed for 25 minute desalting experiments of biochemical materials. It was necessary to modify this equipment so it could operate continuously for 24 hours, accomodate the test materials and provide data on electrode performance. The effects of thermal processing, irradiation and iodine doping on electrode durability were studied. Three hundred hours of materials testing, was completed this year. Irradiation, thermal processing and iodine doping improved the performance of carbon filled EVA. Although the EVA samples prepared for this project did not achieve the durability desired for commercial applications, additional materials development and treatment studies may produce economical plastic EDR electrodes.

#First Award - Patent and Trademark Office/U.S. Department of Commerce/Patent and Trademark Office Society
First Award - U.S. Navy
Second Award - American Water Works Association
Third Award - American Chemical Society
Third Award - ISEF/Chemistry

CONDUCTIVE POLYPYRROLE

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Polypyrrole is a member of an elite group of polymers which, with the incorporation of a dopant anion, exhibit high electrical conductivity. Conductive polymers have many practical uses, such as rechargeable batteries, light weight wire, low mass circuit boards, and in electrochromic display devices. The objective of this project was to determine what concentration of dopant anion would yield the highest conductivities in polypyrrole films. In addition, plans were developed to discern whether the choice of dopant anion would also affect film conductivity. It was predicted that if polypyrrole films contain different anions at various concentrations then the conductivity would vary directly with anion concentration. It was also hypothesized that films containing various anions at similar dopant levels would display no difference in conductivity.

Polypyrrole is an oxygen sensitive material, therefore, all experiments were designed to be carried out in an oxygen free environment. Due to this fact, all laboratory work was done at the Department of Polymer Science and Engineering at the University of Massachusetts, Amherst. Apparatus used extensively were the dry box and a glove bag; under argon or nitrogen, respectively. The anions I^-, Cl^-, NO_3^-, and ClO_4^- in polypyrrole films were tested at concentrations ranging from 0% to 100% of the maximum dopant level. The data obtained strongly supported the hypothesis and repetitions of the experiments yielded similar results. It appeared that polypyrrole film conductivity varied directly with dopant anion concentration. The data also indicated that the type of anion used did not affect film conductivity.

#Third Award - ISEF/Chemistry

MAKING A SUPERCONDUCTOR USING COMMUNITY RESOURCES

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PURPOSES: 1) to duplicate the Meissner Effect on a Superconducting pellet constructed exclusively from resources found in a high school student's community. 2) to build a model demonstrating property of resistivity 3) to produce two video journals
THEORETICAL BASIS OF PROJECT: In simple terms, superconductivity is the ability of a material to conduct an electric current with almost zero resistance. Superconductors exhibit a unique property--a diamagnetic character. This is demonstrated through a phenomenon called the Meissner Effect. Here is my explanation of the Meissner Effect: When a magnet is passed over a regular conduct a flow of electrons or current is induced. Resistance may stop this flow. In a cooled superconductor the current continues to flow and creates a magnetic field equal and opposite to that of the magnet. These two magnet fields "cancel out" each other and the magnet is suspended above the superconducting disk.
MATERIALS: All the materials (chemicals, die, etc.) used were obtained through nine community resources.
RESULTS: All of the purposes were successfully accomplished.
CONCLUSION: An important aspect of scientific research is the ability to duplicate a new discovery. The successful preparation of a superconducting pellet by a high school student, only months after the initial discovery, suggests that high school students can gain entrance into a body of scientists at the vanguard of scientific progress.

CHLOROFLUOROHYDROCARBON FILTRATION

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This project's purpose is to filter chlorofluorohydrocarbons before they are released into the air. Once chlorofluorohydrocarbons (CFC's) are released into the air, Chlorine, a compound in CFC's, destroys Ozone which forms a protective layer around the earth.

In this project a Carbon-precoat filter (A carbon filter with a contained precoat combined with a Adhesive filter) was used to remove the Chlorine from 1.1.2 Trichlorotrifluoroethane(a CFC), but the CFC had to still had to remain a active freon. The procedure used to filter the CFC was simulating a compressed aerosol can where CFC's are normaly found. An air compressor was conected to rubber tubing where 20 ml of 1.1.2 Trichlorotrifluoroethane was conected,after the air passed through the CFC's, the air now was containing CFC's, it passed through a carbon precoat filter into a storage container where the filtered CFC's were transfered to N.I.H. in Bethesda, Maryland for analysis. The analysis showed that the the filtered 1.1.2 Trichlorotrifluoroethane no longer contained Chorine. This proved that the filter was effective for 20ml of CFC's or a 30 gallon aerosol can and it allowed the passage of the product using the propellants(CFC's).

In conclusion I found that a Carbon-precoat filter would be effective for the removal of Chlorine from chlorofluorohydrocarbons before they where dispersed into the air.

For future research I would like to sell my patented filter to a CFC manufacturer and research other ways of protecting the Ozone Layer.

#Second Award - U.S. Air Force

PENETRATION OF SALTS WITHIN PROCESSED COTTON FIBERS

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Electron probe X-ray microanalysis was conducted on cryosections of processed cotton cellulose fibers previously soaked in solutions of 15% dextran and salts. In the fiber samples present in 100 mM NaCl and 100 mM KCl, the intrafibrillar sodium and chloride concentrations were about twice those of the environment. In the fiber sample present in a mixture of 50 mM NaCl and 50 mM KCl, only the chloride ion was concentrated over the environment. Apparently, the increased chloride anion in the cellulose was needed to charge-balance the sorbed cations. It is proposed that the fiber's processing caused structural alterations in the cellulose that electrostatically attracted the cations. A crown ether-like ion selective complexone within the cotton fiber is suggested to explain the preferential sorption of potassium over sodium seen in the data. The failure of the samples with lower concentrations of sodium and potassium to demonstrate a significant sorption of the cations suggests that an auto-cooperative binding process may occur.

#Third Award - ISEF/Chemistry

ANALYSIS OF COLLIGATIVE PROPERTIES OF TANGERINE PEEL SOLUTION TO PREVENT THE FREEZING OF VEGETATION: A 4-YEAR STUDY.

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PURPOSE: To find an economical freeze protector.
YEAR 1: Tangerine peel solution protected tomato plants from freezing. YEAR 2: Analyzed the inorganic compounds in tangerine peel and found magnesium and potassium oxides protected plants. YEAR 3: Analyzed the colligative properties of organic and inorganic compounds of tangerine peel. Found that 1 and 2 molar solutions of magnesium sulfate, potassium sulfate, potassium phosphate and ethylene glycol protected plants from frost and freezing temperatures.
YEAR 4: In the current study, slurries were made by grinding tangerine peels and then distilling some with water and some with ethyl alcohol. Some of the slurry was also filtered and then distilled. Commercially prepared d-limonene (a compound in tangerine peel) was also tested. All preparations were tested on tomato, corn and citrus seedling plants. 50ml of each solution was diluted with one liter of distilled water and sprayed on the plants for a sensitivity test. The d-limonene burned plant leaves at this strength and was reduced to 25ml/l. and retested. Groups of plants were sprayed with each solution and subjected to temperatures of -2, -4, -6 and -8 degrees celsius for 30, 45, and 60 min. timed tests in a domestic chest freezer. Distilled water was used as a test standard. RESULTS: All of the standard plants died from freeze damage. The d-limonene plants sustained some leaf damage on the 30 & 45 min freezes. During the 60 min. test, the leaves were badly damaged but stems remained unhurt & sprouted new growth after 4 days. The tangerine solution plants were unhurt through the 30 & 45 min. tests, however, during the 60 min test the leaves became wilted, but the stems were unhurt & sprouted new growth after 4 days.
CONCLUSION: The product "No Frost" developed by the experimenter from the distilled tangerine peel slurry, protected vegetation from frost and freezing temperatures.

BLEACHING

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Stains on various materials are a fact of life. Bleaching is one effective method of stain removal.

The purpose of this project was to determine which bleach was the most effective on various stains on different types of material.

The procedure used involved staining white samples of 100% cotton, 50% cotton/50% polyester, 100% polyester, and 100% wool material with grape juice, coffee, blue dye, and scorch. Three oxidizing bleaches, sodium perborate, hydrogen peroxide, and sodium hypochlorite were used, as well as two reducing bleaches, sodium hydrosulfite and titanium stripper. Each bleach was applied to each stain on each of the four types of material.

It was concluded from this experiment that sodium hypochlorite was the most effective bleach, but resulted in damage to some fabrics. Hydrogen peroxide was the safest, effective bleach. 100% polyester was the easiest fabric to bleach.

This experiment proved that the type of bleach selected must be determined by the type of stain and type of material on which the stain is present in order to produce safe, effective results.

ADULTERATION OF FRUIT JUICES

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The problem selected for the investigation dealt with possible adulteration of ascorbic acid content in canned fruit juices as compared to fresh juice. Investigations involved Vitamin C testing for three different brands each of grapefruit juice, orange juice and tomato juice. A total of 96 titrations were performed to determine if Vitamin C content was affected by storage in open or closed containers and the effect of storage container material on the deterioration of Vitamin C, if any, within a 24 hour period. A comparison of original Vitamin C content in the canned juices was made in comparison to fresh fruit juices. A water content comparison was also made in relation to the various brands and juices.

Water adulteration is not a problem, ranging from 1-3% in canned fruit compared to fresh juice.

The fresh opened canned juices were adulterated by the method of storage after purchase and open or covered storage in the refrigerator. The average loss of Vitamin C was in the range of 11-48%.

The greatest adulteration involves price and Vitamin C content comparisons. Not all juices contain the same Vitamin C content. The U.S. RDA daily ascorbic acid intake is 60-70 mg daily. TEXSUN Orange Juice met this recommendation with 73 mg/100 ml; however, with the other two brands tested 1½ cans are necessary for equivalent of Vitamin C. All Grapefruit Juices tested met minimum U.S. RDA standard of 30 mg/100 g, which means that two cans of each brand are required to meet recommended daily intake of Vitamin C. DEL MONTE Tomato Juice met U.S RDA daily ascorbic acid intake with 77 mg/100 ml; however, with the two other brands tested three cans of the juice are needed to satisfy daily intake.

The Effect of Certain Factors on a Spider Web's Strengths

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Purpose/Hypothesis-The purpose of this research is to determine the effect of certain factors on a web's weight-bearing and tensile stretch. The Hypothesis is, the experimental factors will effect a web.

Procedure-Webs were collected, then treated with the vairables. The webs were then tested for tensile stretch and weight-bearing on a modified caliper.

Results-Most of the vairables decreased the strength of the webs. Tap water increased the tensile stretch the most, while meat tenderizer decreased the weight-bearing the most, and the 30 seconds of exposure to microwaves had the least effect on weight-bearing.

Conclusion-Most of the factors denatured the 3° structure of the protein in the web so that the strengths changed.

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#A COMPUTER STUDY OF 3-D POLYMER CONFORMATIONS AND CONFIGURATIONS

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The purpose of the project is the study of three dimensional conformations of organic polymer molecules using computer simulations to model the chains. A computer program calculates the x, y, and z coordinates of successive carbon atoms on a growing chain, plus the coordinates of the appropriate side atoms, allowing random location of atoms on a circle of rotation defined by the appropriate bond lengths, and the tetrahedral bond angle, 109.5 degrees. Each chain thus produced represents one of many possible conformations. In addition, Van der Waals radii are used in the present model to take into account steric interactions and the excluded volume effect. Two measures of the size of different conformations are looked at-- the radius of gyration, R_G, and the end-to-end distance, R_E. Averages and standard deviations of these two measures are taken over large numbers of possible conformations for three polymers: polyethylene, and the isotactic, syndiotactic, and atactic configurations of polypropylene and polyvinyl chloride(PVC). Results of numerical experiments include: (1) Verification of "pentane interference" and development of a computer routine to overcome this terminating effect, (2) Verification of the nearly linear relationship between H_G and R_E and between R_E and SQR(N), where N is the number of bonds in the chain; (3) "Apparent" unit length measures and characteristic ratios for each polymer studied for comparison to references; and (4) Configurational symmetry for the side atoms is compared via R_G and R_E for polypropylene and PVC. Other investigations include a calculation of conformational energies, temperature and solvent effects, and heat capacities for polyethylene.

#London International Youth Science Fortnight Trip - U.S. Marine Corps
First Award - ISEF/Chemistry
Second Award - American Chemical Society

THE DEGRADATION OF RIBOFLAVIN WHEN EXPOSED TO ELEMENTS OF ZINC FAMILY

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Earlier experimentation with riboflavin (vitamin B_2) has shown that, when exposed to copper, iron, aluminum, and tin; riboflavin in a water solution does not significantly degrade. Experimentation has shown, however, that zinc significantly catalyzes the degradation of riboflavin. Since zinc was the only element tested that degraded riboflavin, the hypotheses were made that the other elements of the zinc family (cadmium and mercury) have the same effect on riboflavin as zinc and that the ability of an element to catalyze the degradation of riboflavin is a periodic function.

To test these hypotheses, riboflavin-water solutions were exposed to each of the elements of the zinc family while under fluorescent light and in the dark. The test period was 24 hours with samples taken periodically. Control samples of pure riboflavin-water solutions were tested likewise. The amount of riboflavin left in each sample was tested by finding the percent transmission of light through each sample using a spectrophotometer and matching that reading with a calibration chart.

The results of these tests supported the hypotheses. Riboflavin in water solution degraded significantly more when exposed to the elements of the zinc family than when not exposed to those elements. It is possible that the catalytic effect of an element on the degradation of riboflavin is a periodic function, but all other elements on the periodic table would have to be tested to prove this theory.

*WHICH PRETREATMENT SOLUTION IS MOST EFFECTIVE IN PREVENTING OXIDATION WHEN DRYING FRUIT?

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The researcher tested apples,pears,and bananas to discover which pretreatment solution worked best in preventing oxidation when drying fruit. The solutions used in the first four experiments were sodium carbonate,sodium sulfate,sodium thiosulfate,saline solution,ascorbic acid, citric acid,lemon juice,and a commercial antioxidant (Fruit Fresh). The fruit was dehydrated after pretreatment.

In Experiment I (full strength solutions) apples pretreated with a saline solution, pears pretreated with citric acid,and bananas pretreated with lemon juice displayed the best results when soaked for ten minutes. In Experiment II (half strength solutions) apples,pears,and bananas pretreated with sodium thiosulfate displayed consistently acceptable results when soaked for ten minutes. In Experiment III (full strength solutions) apples and pears dipped in sodium thiosulfate and bananas dipped in citric acid displayed the best results. In Experiment IV (half strength solutions) apples in sodium thiosulfate and lemon juice,pears in sodium thiosulfate and saline solution and bananas in lemon juice,all dipped,displayed the best results.

New chemicals introduced in Experiments V and VI were sodium borate, sodium citrate,potassium nitrate,sucrose,potato starch,baking powder, calcium hydroxide,and lime juice.

In Experiment V (full strength solutions) apples and pears in lime juice and bananas in sodium citrate and lime juice, both dipped, consistently displayed acceptable results. In Experiment VI (half strength solutions) apples dipped in lime juice did best. In all three trials lime juice and potato starch did best on pears and bananas.

*Fourth Award - ISEF/Chemistry

HIGH PERFORMANCE THIN LAYER CHROMATOGRAPHY

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PURPOSE: To analyze selected polymeric structures of several polyvinyl chloride and thermoplastic elastomer products (PVC) wallcovering, upholstery material, and refrigerator gasket for identifying plasticizers.

PROCEDURE: These common plasticizers (dioctyl phthalate, polymeric polyester, dioctyl azelate, and mineral oil) were tested for and extracted from the plastic and analyzed by the TLC techniques. Specimens were cleaned with methanol and boiled in chloroform while glass plates coated with silica gel were heated. Tracks were etched and dissolved samples were spotted onto the plates. These were then developed with methylene chloride, allowed to dry, and sprayed with a methanol solution of iodine to fluoresce the tracks. Spot positions were related to the polymeric chain lengths by equalizing the masses of DOP and polymeric polyester. Comparison with the "known sample" chromatograms aided identification.

CONCLUSION: HPTLC extraction techniques provide valuable qualitative and quantitative data for study and identification of plasticizers. The simplicity of the TLC procedure allows simultaneous testing of several samples for easy comparison. The HPTLC extraction techniques proved that DOP was located in the PVC specimens, and mineral oil was found in the TPE product. The refrigerator gasket contained 10.77% DOP and 20.26% polymeric polyester. Polymeric chain lengths appeared to be the factor determining spot positions--not mass or density.

* CHEMICAL ANALYSIS OF ARTOCARPUS ALTILIS LATEX

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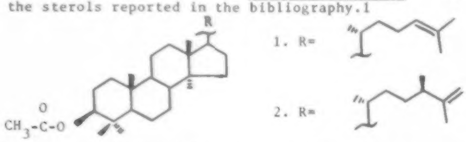
The purpose of this reasearch was to identify the chemical components from the breadfruit tree (Artocarpus altilis) latex, especially to separate and identify the natural steroids that contains. The latex was collected from the bark of the tree of Artocarpus altilis. It was insolated and purified following literature procedure. The following chemical analysis were performed on sample of the latex: 1. Thin Layer Chromatography(TLC) 2. Column Chromatography 3. Infrared Spectroscopy (IR) 4. High Performance Liquid Chromatography(HPLC) 5. Proton and Carbon-13, Nuclear Magnetic Resonance(1H-NMR,C-13NMR) 300Mhz 6. Gas Chromatography Mass Spectroscopy(GC=MS).

It was discovered in the latex from Artocarpus altilis contains important and useful chemical compounds such as natural steroids. 4,4-dimethyl-5α-cholesta-17,24-dien-3β-yl acetate, is one of the two posible steroid found in the latex from Artocarpus altilis. This steroids are not the sterols reported in the bibliography.1



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*Fourth Award - ISEF/Chemistry

ORGANIC SYNTHESIS OF ENZYME INHIBITORS

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Put simply, the accomplishment of this project is the synthesis of a compound that has never been made before. To appreciate the significance of this synthesis, attention must be paid to the reasons this project was undertaken.

Fatty acids are metabolized in the body through structures called mitochondria. The process by which these fatty acids are metabolized involves the transport of fatty acids across the inner mitochondrial membrane for oxidation. The process of fatty acid metabolism involves a substance called carnitine, which is present in the body naturally and also supplied nutritionally. However, when disease decreases the level of carnitine in the body, fatty acid metabolism is diminished, causing a loss in the amount of energy supplied to the body.

Two enzymes, carnitine palmitoyltransferase (CPT) and carnitine acetyltransferase (CAT), have been discovered to be essential in the transport of fatty acids; research is being done to learn more about their active sites, leading to speculation as to a replacement molecule for carnitine in those systems in which carnitine is deficient. Information on active sites is gathered by synthesizing enzyme inhibitors, which bind in varying degrees to an enzyme's active site. This bond strength is measured by the Michaelis-Menton constant K_i, and this measurement can be used to design new inhibitors. The inhibitor that has been synthesized as a result of this project is called Hemipivaloyl carnitinium (HPivC). It has been sent for testing with the various enzymes, and the results are discussed in the paper.

REMOVAL OF IRON FROM KAOLIN

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The removal of iron from kaolin is a major processing cost and research endeavor for kaolin companies. Recent literature states that algae has been used to remove heavy metals from industrial waste. This project evaluates the use of duckweed, a small, free-floating, water plant, to remove the iron from kaolin.

The following experimental procedures have been developed.

1. Grow duckweed in iron present and iron not present nutrient solution.
2. Grow duckweed with roots in contact with kaolin.
3. Determine the amount of iron present in duckweed by oven drying, ashing, solubilization in a Parr bomb, and atomic absorption spectroscopy.
4. Determine the amount of iron present in kaolin by oven drying, solubilization in a Parr bomb, and atomic absorption spectroscopy.
5. Establish the standards and protocol for the multiple additions method of atomic absorption spectroscopy.

The data obtained to this point indicate the following conclusions.

1. The iron content of duckweed is affected by the iron content of the medium in which it is growing.
2. Duckweed reduces the iron concentration of high iron content kaolin but not of low iron content kaolin.
3. The iron content of duckweed is higher when kaolin is the only source of iron, than when there is no iron in the nutrient.

A COMPARISON OF THE PARAMAGNETISM OF TRANSITION METAL IONS AND THEIR ELECTRON CONFIGURATIONS

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The purpose of my project was to determine that there is a relationship between the electron configuration of certain transition metals and the effects produced by a magnetic field on solutions of compounds composed of those elements. Also, by observing the electron configuration of transition elements, it should be possible to predict which compounds of these metals would produce an effect when their solutions are placed in a magnetic field.

Various transition element compounds were dissolved in water and then portions of the solutions were allowed to recrystallize. During recrystallization the solutions were exposed to a magnetic field. The physical effects were observed, then the effects were compared to the compound's electron configuration.

It was observed that solutions of compounds containing chromium produced the greatest effect among the transition elements when exposed to a magnetic field. There was a direct correspondence between (a) the number of unpaired electrons in the 4s and 3d subshells and (b) the effects produced when solutions of those compounds are exposed to a magnetic field.

Thus, it is concluded that, when a solution of a compound containing a transition element produces a noticeable effect when exposed to a magnetic field, the transition element has a high number of unpaired electrons in the outer electron shells.

SYNTHETIC SKI WAX

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PURPOSE: To formulate waxes which have similar properties, including slip characteristics, to three commercially available ski waxes.

PROCEDURE: Temperature ranged, color coded ski waxes were separated into fractions using solvent extraction. Using modified ASTM methods, drop points, haze points and congealing points were determined on these fractions. Similar tests were run on commercially available petroleum based waxes and the results matched with those of the fractions. Synthetic blends were then made to match the original yellow, red and green waxes. Once the synthetic waxes were formulated, manual penetration depths were compared on the bulk wax. Wax films were applied to pretreated laminate boards. Slip comparisons were made on a 27° inclined plane recording the time required for a standard object to run down a set distance. These slip comparisons were made at room temperature and also after the boards had been subjected to -10°C.

RESULTS: It was necessary to reformulate two of the waxes. The green wax showed crazing after being placed in the freezer and the yellow wax showed too much of a variation on the slip test.

CONCLUSIONS: The color coded ski waxes are combinations of waxes designed to alter the coefficient of friction, which is temperature sensitive. The synthetic waxes appeared to have very similar properties and slide characteristics, especially at -10°C.

REFLECTIONS: Solvent extraction proved to be a very efficient method of separating the waxes. Better blends of synthetics could have been made had a wider variety of petroleum based waxes been available for formulation and more sophisticated methods of evaluating the wax's hardness and flow characteristics were used.

WHICH GASOHOL RATIO PRODUCES MORE ENERGY?

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The purpose of this project is to determine the highest heat energy of different proportional amounts or ratios of ethanol and gasoline. This experiment examines other fuels, specifically ethanol, and its possible future as a viable source of energy.

For each of the thirty-three experiments 2g. of fuel was measured in ratios by ten percent. Tap water was measured in amounts of 40g. to be heated.

These are the results of gasoline:ethanol in kilocalories:

	100:0	90:10	80:20	70:30	60:40	50:50	40:60	30:70	20:80	10:90	0:100
test 1	2.760	2.800	2.800	2.800	3.000	2.840	2.840	3.040	2.920	3.200	2.880
test 2	2.600	2.720	2.840	2.720	2.920	2.840	2.800	3.040	3.120	3.160	2.960
test 3	2.520	2.840	2.840	2.840	2.960	2.800	2.920	2.880	3.200	3.000	2.880
average	2.627	2.787	2.827	2.813	2.960	2.827	2.853	2.987	3.080	3.120	2.907

The 10:90 ratio of gasoline:ethanol was the ratio to produce the highest heat energy. I have observed and concluded that ethanol produces very hot flames. To gain the most heat energy from ethanol, it apparantly needs the aid of a substance which is in gasoline. This calls for further research on these fuel sources.

* NON-STOICHIOMETRIC GROWTH EFFECTS IN THE ALUM/CHROME ALUM ALLOY SYSTEM

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In aqueous solution growth of multi-component solids, the phase which crystalizes is sometimes strongly dependent on the composition of the growth solution. This work seeks to determine the compositional and structural dependence of alum, chrome alum, and alloy mixtures on the chemical makeup of the solution. Usually, the ion ratios in the growth solutions are stoichiometric to the recrystalized solid. In this experiment, these ratios were altered to create various non-stoichiometric growth conditions.

Compositional or structural changes induced by non-stoichiometry were examined using atomic absorption spectroscopy (AAS) or emission spectroscopy (ES), X-ray diffraction powder patterns, and a Nomarski interference contrast microscope. The AAS and ES established the ratios between K, Al, Cr, SO, and the other impurity ions. This ratio was used to find the segregation coefficient for chromium, k, in the alloy crystals, where k_{Cr} = Cr content in solid/Cr content in liquid. X-ray diffraction powder patterns verified a suspected phase change to cesium cromium sulfate and allowed definite identification of the remaining samples.

It can be concluded that (1) for stoichiometric alloy growth, $k_{Cr} = .7$, (2) the addition of excess Al^{+++} and Cr^{+++} accentuates the segregation of Cr away from the solid ($SO_4^{=}$ is not responsible for these effects), (3) small alkali metals do not displace K, (4) large alkali metals are readily incorporated: a) $k_{Rb} = 1.5$, yet no change in k_{Cr}, b) Cs forms Cs-rich β-alum (probably Al-free).

*Fourth Award - ISEF/Chemistry

THE DETECTION AND ABSORPTION OF NICOTINE IN SALIVA AND THE HUMAN BODY.

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The objectives of thsi project were to extract and find the amounts of nicotine in the saliva of tobacco chewers and to find and absorption rate at which the nicotine is taken into the body.

Samples were taken from chewers before, during and after they had chewed the tobacco to determine the range of the levels of nicotine in the saliva.

These saliva samples were extracted with a TCA treatment, to remove the nicotine for examination. The extracted samples were then analyzed by HPLC.

The average amount of nicotine taken into the body was found to be 19.5 mg when the subject chewed the tobacco for 15 minutes. The nicotine was detected up to 30 minutes after the subject had stopped chewing.

*Third Award - ISEF/Chemistry

ELECTROLYSIS OF MIXED SOLUTIONS

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The purpose of these experiments was to determine if the amounts of copper and hydrogen produced by the electrolysis of copper sulfate and sulfuric acid were relative to the percent of copper sulfate used.

This was accomplished by electrolysizing mixed solutions of copper sulfate and sulfuric acid in varying ratios. Each experiment was performed twice with an improvement in the apparatus between the first and second experiments.

Graphs were plotted of the amount of hydrogen produced versus time and of the moles of hydrogen and copper produced versus the percent of copper sulfate. Charts of the effeciency of the apparatus at different solutions were also made.

SODIUM ION REMOVAL FROM IRRIGATION WATER

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As a result of the death and stunted growth of blueberry plants, tests were run on the irrigation water and soil. It was concluded that the water used to irrigate these plants was very high in sodium content (sodium bicarbonate). This sodium burned the roots. As a result, the water was treated with sulfuric acid which neutralized the pH. This treatment has worked on small scale operations, but it could be too expensive to use on a large scale. The purpose of this project is to try to find a substitute for sulfuric acid that is cheaper and easier to use on a large scale basis. First, water samples had to be taken, and standards had to be made using Na_2SO_4 (sodium sulfate). Next, the water had to be run through a medium of Dowex 50, a plastic organic matter. Finally, these samples had to be tested on the Atomic Absorption Spectrophotometer. The water samples that were tested without being treated with the Dowex 50 had to be diluted because sodium content was so high. The water that had been treated by the Dowex 50 was very low in sodium content and poses no threat to the plants' life. It was concluded that Dowex 50 can be used to remove sodium ions from water.

WHICH PLASTIC WRAP WOULD YOU RATHER BE BURIED IN?

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The purpose of this project is to identify the overall most healthy and favorable food wrap, using stretch length, gas and water permeability, clinging ability, thickness of the film, IR Spectrophotometer, public opinion, reaction to chemicals, microwave oven testing and melting points as experimental factors.
Three kinds of composition found are Polyethylene, Polyvinyl Chloride, and Ployvinylidene Chloride. Based on the results, Saran wrap, made of Polyvinylidene Chloride is considered to be the most healthy and recommendable plastic food wrap. Its high melting point, low moisture lost, low permeability and strongly bonded film are characteristics that surpasses even the most commonly manufactured Polyethylene.

EFFECT OF CYANOCOBALAMIN ON PLANTS

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This experiment was performed in order to determine the effects of cyanocobalamin on plants. Cyanocobalamin, or vitamin B_{12}, is used by humans to produce DNA, prevent pernicious anemia, and allow the nervous system to function properly. Its effect on plants is not yet fully understood.

Over a ten week period, two different solutions of vitamin B_{12} were given to two different experimental groups. A control group was given water only. Experimental plant group (A) received a 1 mcg/ml of vitamin to water solution and experimental group (B) received a 10 mcg/ml of vitamin to water solution. Measurements were recorded weekly.

From the data collected the following observations and conclusions were noted. Group (B) grew at a slower, but more consistent rate. More leaves appeared on all plants in group (A) and (B) than the control group. Plant vigor was noted in both experimental groups. Group (B) plants appeared a darker shade of green than the others.

A chlorophyll chromatography test was performed on all three groups. The results showed a higher concentration of chlorophyll-b levels in experimental group (B). It also showed experimental group (B) had a lower concentration of chlorophyll-a levels. Due to this information it was concluded that the vitamin was absorbed through the roots as a nutrient and was stored in the plant's leaves. These similarities in the molecular structure in chlorophyll and vitamin B_{12} may have caused a change in the plant's photosynthesis process which caused the change in growth rate and color.

Study of mineral carbonates through termic analysis

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Mineral carbonates are thermically active substances which decompose through temperature increase liberating heat. Based on these chatacteristics, and that, in a differential thermica analysis, the peak area of calcite, magnesite and dolomite are proportional to their masses, synthetic standards were built, from graphs were obtained of their thermic behaviour up to 1000ºC.

In the works that were researched there are references agreeing with the fact that the area between the peak and the base line of a differential thermic curve is proportional to the mass of thermically active substances.

The synthetic standards were built as from calcite and magnesite mixtures that were considered pure. After obtaining the differential thermic analysis graphs peak heights and their areas were measured. Taking as a base the calcite peak and area, due to its regular behaviour.

As from the differential thermic analysis of dolomite with a known chemical composition (CaO = 29.7 and MgO = 21.9), conclusion was arrived at that the measurement of the peak area is more adequate than the measurement of the peak for quantitative works on limestones.

*THE USE OF HYPOCHLORITE IN THE OXIDATION OF CYCLIC SECONDARY ALCOHOLS

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In this study, the feasibility of using hypochlorite in kinetic studies of the oxidation of secondary alcohols has been investigated. Specifically, hypochlorite in the form of swimming-pool chlorine was used to oxidize the cyclic secondary alcohols cycloheptanol, cyclohexanol, cyclopentanol, and the straight-chain secondary alcohol 2-hexane.

The kinetics of the reactions were studied under a variety of reaction mixture/solvent combinations, and a 50% acetonitrile - 50% water/acetic acid reaction mixture/solvent combination was determined to be the most appropriate of those tested for successful kinetic analysis. Additionally, the kinetics of the reaction were studied at a variety of temperatures and alcohol concentrations. From kinetic data, specific rate constants were determined, and activation energies of the four different alcohols were calculated. Because this study examined three different cyclic alcohols, it was possible to study the relationship between the structure of the alcohols and their relative reactivities.

Conclusions were drawn about the effects of angle strain, torsional strain, and Van der Waals (steric) strain upon the relative stabilities of cyclic alcohols with different-sized rings. The reactive properties of 2-hexanol were also studied; this allowed 2-hexanol to be used as an unstrained reference alcohol. In addition, practical and industrial applications of the use of hypochlorite as an oxidant were investigated.

*Third Award - ISEF/Chemistry

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*THE RATE OF LEAD IODIDE CRYSTAL DIFFUSION IN SILICA GELS

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Gels may be used to serve as diffusion media in the growth of crystals. The rates of the lead iodide crystal diffusion of gels of 1M acetic acid and varying concentrations of sodium silicate, with distances measured from the gel interface, were calculated and compared for a twelve-hour period. 1M lead acetate was mixed into the gel. On the addition of 2M potassium iodide, an orange precipitate of lead iodide began to diffuse through the gel. The prime range of concentrations of sodium silicate for the experiments lay between 1.0mL:7.0mL to 2.0mL:7.0mL, the complement being distilled water. The percent differences were calculated between the rates of each experiment at 6 hours after the initial reaction. Comparing the rates of 1.0mL and 1.5mL of sodium silicate, a percent difference of 2.15% was calculated. Comparing 2.0mL of sodium silicate to 1.0mL and 1.5mL, a percent difference of over 30% was calculated. The low enough percent difference between 1.0:7.0 and 1.5:7.0 lends some credence to the notion that low concentrations of sodium silicate in the gel will not sensitively affect the diffusion constants of lead iodide. The large percent difference between 2.0:7.0 and the other concentrations must be around the critical region where the concentrations of the sodium silicate begin to affect noticeably the rate of lead iodide diffusion.

*Fourth Award - ISEF/Chemistry

* DEGRADATION OF ALKALOIDS IN TANSY CONTAMINATED SILAGE

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Tansy ragwort, Senecio jacobaea, is a serious weed problem in the Pacific Northwest and other parts of the world. It contains six kinds of toxic agents called pyrrolizidine alkaloids (PA). Senecio-contaminated hay or silage causes irreversible liver damage in livestock and herbal use of PA-containing plants causes veno-occlusive diseases in humans.

This study was designed 1) To determine degradation rates of the alkaloid, jacobine, in tansy-contaminated silage, and 2) To improve solid phase extraction of the pyrrolizidine alkaloids.

Tansy was mixed with grass at 12, 29, 44, and 67% (wet weight) and placed in containers to simulate silage-making conditions. Core samples were taken over six weeks and extracted with methanol. The alkaloid was cleaned by solid phase extraction and analyzed using HPLC (High Performance Liquid Chromatography). Changes in alkaloid content with time (6 weeks) were determined.

After six weeks, the samples contained about the same amount of degraded alkaloids, regardless of initial tansy content. Complete degradation occurred with subsequent atmospheric exposure. Samples run from three containers of 12% tansy-contaminated silage were analyzed to check the procedure.

Tansy-contaminated silage seemed to become less toxic with storage, especially, more than six weeks. The bacteria that ensiles grass may also metabolize toxic alkaloids and decrease toxicity in tansy-contaminated silage.

*Fourth Award - ISEF/Chemistry

* SUPERCONDUCTORS : IS CALCIUM A POSSIBILITY?

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Superconductors are a means of transporting electricity without the resistance that would normally occur with metallic based conductors. Utilization of a compound containing calcium, copper and gadolinium oxides, which has been previously untested for its superconducting capabilities, could result in a more cost-efficient solution to the energy problem ($10 billion/year).

In an effort to determine if calcium could be used as a superconductor, 1.81 grams of Gd_2O_3, 2.39 grams of CuO and 3.95 grams $CaCO_3$ were ground together with a mortar and pestle. These chemicals were baked in a kiln at 900^o-950^o Celsius for 12 hours and cooled for 6 hours. This ceramic compound was compressed in a hydraulic press at 1.03×10^5 to 1.17×10^5 kPa. The baking process was repeated for an additional 18 hours and cooled for 6 hours. Clay crucibles, which had previously been fired 5 times, were used to hold the chemicals during baking.

Upon examination of these baked and compressed chemicals, it appeared that a reaction had occurred between the chemicals themselves and the clay crucible resulting in a glass-like substance. This project was unable to assess this calcium compound as a superconductor because the chemicals used were contaminated by the clay. Future research would necessitate the use of a metallic crucible before liquid nitrogen in coordination with a samarium cobalt magnet could verify whether or not this compound could serve as a superconductor.

*First Award - American Chemical Society
First Award - U.S. Air Force

* DISSOLVING YOUR CORN INTO HARD CASH

Daley, Michael A.
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The purpose of my project was to synthesize a polymer sealer.

First, I tried to crosslink starch using SURFYNOL 104E with a combination of initiators and catalysts. Then I tried to make two sealers. The first sealer was synthesized by heating starch, urea, and water. The second sealer was prepared by heating starch, cysteine, and water.

At first, I tried to make a sealer which would protect white marble against acid rain deterioration. Inadvertently using the latter condensation polymerization, I developed a product which could be processed into biodegradable packaging. Through the addition of different plasticizers and crosslinking agents, various physical properties could be attained including a range of forty to one hundred percent solubility in water.

***Second Award - ISEF/Chemistry**

IRON SHAVINGS IN CEREAL

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The purpose of this study was to determine amounts of iron in various brands of iron fortified cereal to determine if the amount of iron varies with the cereal's descending level within a given box. After magnetically extracting the iron and dissloving it in dilute hydrochloric acid, the absorbance of iron was determined spectrophotometrically. The greatest amount of iron was in the lower half of the box, thus supporting the hypothesis that the iron shavings do tend to settle to the bottom during handling. Not only do different brands appear to have different amounts of iron filings, but different boxes of the same brand have different amounts of iron.

COULD CORN SOLVE OUR AIR POLLUTION PROBLEMS?

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The purpose of this experiment is to determine some characteristics of ethanol emissions and compare these to the same characteristics of gasohol, regular and unleaded gasolines.

First, I ran each of the gasolines in a 3 horsepower engine. The exhaust hose was put in bottles of water. These mixtures were then tested for acidic content of any solids that might have been given off by evaporating the mixture and putting them through filter paper. The temperature of the exhaust was also taken.

My experiment found some interesting things. The ethanol tested the least in acidic and solid content followed by the gasohol, unleaded and regular gasolines. An experiment done earlier in the year using gasoline flame emission, tested the acidic content to find similar results. The ethanol measured 5.5, gasohol 5, unleaded 4.5 and regular 4. The temperature of the ethanol was the lowest at 194 degrees followed by the regular, gasohol and unleaded gasolines.

I've concluded that the ethanol was the best fuel tested because it tested to be the least harmful to the environment.

I am also currently running an ion test.

A NEW METHOD FOR THE PREPARATION OF METHYL BENZIMIDAZOLE CARBAMATES: POTENTIAL ANTIFILARIAL AGENTS

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Filariasis is a group of parasitic diseases that infect over 300 million people in the world today. This disease unfortunately affects the people of the third world, especially in Africa and Asia, where the people are hardly able to protect themselves of the disease.

A few drugs are currently used for the treatment of *O. volvulus* and *W. bancrofti*. But these drugs have certain disadvantages. There are no real safe drugs for the treatment of the adult worm of either disease. One class of experimental drugs which have demonstrated a fatal effect on the adult is the methyl benzimidazole carbamates. However, these drugs are limited because they can not be absorbed by the digestive system.

The purpose of this project was to develop a potential antifilarial drug for the treatment of this disease which has oral activity. In this project I have developed a new method using 2-chloro-1-methylpyridinium iodide to make methyl benzimidazole carbamates. This method has been compared with the use of another ring closing reagent, dicyclohexylcarbodiimide (DCC). Three methyl benzimidazole carbamate type compounds were prepared to test this new method. The compounds were characterized by Thin Layer Chromatography, and Nuclear Magnetic Resonance. The method showed to be easier and more efficient than that of using DCC. The compounds prepared are to be tested for antifilarial activity.

I hope this new method of forming methyl benzimidazole carbamate types and the compounds I have made for this project will aid in making it possible to rid the world of filarasis, especially river blindness and elephantiasis in the third world.

A 2-YEAR STUDY OF OSCILLATING REACTIONS WITH IO_3^- AND BrO_3^- IONS AT 22°C

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A two-year study has been conducted examining the oscillating Briggs-Rauscher(BR) and Belousov-Zhabotinsky(BZ) reactions. The effects of temperature and $[IO_3^-]$ (for BR) or $[BrO_3^-]$(for BZ) on the number of oscillations (in a reaction) and the oscillation time period were studied for the two reactions. The effects of $[IO_3^-]$ and $[BrO_3^-]$ on the time before oscillations begin were studied. The effects of $[H_2SO_4]$ on time period were studied for the BR reaction. Conclusions: temperature, $[IO_3^-]$ (or$[BrO_3^-]$), and$[H_2SO_4]$ (for BR only) vary indirectly with oscillation time period; $[IO_3^-]$ (or$[BrO_3^-]$) vary indirectly with the number of oscillations and with the time before oscillation begins. Temperature, however, varies directly the number of oscillations.

Experiments thenceforth centered on the BR reaction. The effects of $[IO_3^-]$, $[H_2O_2]$, $[H_2SO_4]$, and $[CH_2(CO_2)_2]$ on redox potential were examined. The effects of light exposure and stirring were studied. Conclusions: conductivity oscillates with time and is affected by the aforementioned reactant concentration variances; light exposure and stirring do not seriously affect oscillations unless totally absent.

A continuous-flow-stirred reactant tank(SCRT) was then constructed with a maximum reactant input rate of 45mL/min and a volume of 500mL using laminar bar stirring at 22°C ± 0.1°. With this CSRT, a relationship of 3/2/6/3/2/5 between six geometrically defined segments of redox-versus-time-graph periods was ascertained - a first step in finding the rates of the intrinsic mechanisms.

* CAN ADDING THICKENING AGENTS LEAD TO GROWING BETTER CRYSTALS?

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Convection currents are currents that disrupt the order of crystal formation. Since the need for perfected crystals is so high, and these currents are such a problem, NASA has begun to grow crystals in space. the absence of gravity in space reduces the flow of the currents, and the crystals are able to settle more properly. This experiment attempts to find a way to grow a more perfect crystal here on earth by adding thickening agents to increase the viscosity of the solution from which the crystals are formed, thereby slowing down the flow of the convection currents. Solutions A-1, B-1, and C-1 were the controls in which additional water was substituted for the thickeners. The test solutions were as follows: A-2: 238.8g H20 + 7.4g of the thickener hydroxyethyl cellulose + 153.8g of ADP, B-2: 295.7g of H20 + 9.1g of the thickener polyethylene glycol + 95.2g fo alum and chrome alum, C-2: 238.8g of H20 + 7.4g of the thickener polyvinyl alcohol + 153.8g of ADP and chrome alum. Crystallization occured in all cases except A-1. The masses of the crystals formed were: A-2, 91.5g; B-1, 60.7g; B-2, 63.5g; C-1, 47.5g; C-2, 64.5g. These results show that the quantity of the crystals with the thickeners was definitely better than that of the crystals without. When appearance was compared the crystals with thickeners were more developed than those without. Therefore it can be concluded that thickeners can be an aid in growing crystals by reducing the effects of convection currents. Further research in this area may provide a more successful method of growing high quality crystals here on earth.

***Honorable Mention - American Intellectual Property Law Association**

DISHWASHING LIQUID EVALUATION

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Cleanliness is part of the important fight against disease. Soap has been used for cleaning for about 5,000 years, but recently scientists have discovered how to make new kinds of detergents, ideal for cleaning. Soap and detergents have many other uses as well. By itself, water is not a good cleaner. Pour water into many surfaces, it forms little streams and puddles, leaving whole areas dry.

The reasons for this project were to find which liquid's suds stand up best, cut through oil and grease best, best cleaning agent, and the best buy for your money. In this project the following tests were conducted: percentage of solids, determination of foam retention time, flash foam formation, relative viscosity, India ink dispersion test, foam stability-in-use test, standard oil or grease tolerance test, standard cleaning test, and the cost per 5 ml of dishwashing liquid. After careful consideration, the results of these tests indicate the following: (1) Dawn suds stood up best over time; (2) Ivory was the best degreaser; (3) Ajax cleaned best; (4) Ajax, Joy, and Palmolive were equal in cost and a little less expensive than Ivory and Dawn. Ivory and Dawn were also equal in cost.

Based on a Summary Rating Table:

On a scale of one through five with one being the most desirable and five being the least desirable. Ajax came in 1st with eight points total. Ivory 2nd with 10 points total, and Palmolive 4th with 11 points total. Dawn and Joy were equal with 13 points each.

* ALTERING THE RANDOMLY OCCURRING ORIENTATION OF THE CALCULATED POLARIZATIONS IN SODIUM CHLORATE CRYSTALS

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Optical activity has been studied by scientists for as far back as a hundred years ago. Yet, it is believed that the phenomenon has influenced aspects of life since the creation of the earth. Today, there is nothing mysterious about the chemical structure of molecules that can take both right-handed (RH) and left-handed (LH) forms. The questions lie in what started the right-handedness and left-handedness and in what ways, if any are they vital to all living things.

In this research a valid attempt has been made to search for some answers by examining the symmetries of the forces acting on matter, along with the symmetries of the matter on which they act. Since crystals furnish one of the most beautiful examples of order and symmetry, they were used in the investigation.

Crystals of sodium chlorate, which randomly grow with levo-and dextro-rotatory polarization were induced to form in solutions whose molecules were of a particular hand. Significance was found in the ratio of (LH) to (RH) crystals as the strength of the rotatory influence was increased. In subsequent investigations a significant preference in handedness was also exhibited when crystals of sodium chlorate were grown on fragments of levo-or dextro-rotatory quartz. In the most recent investigation, crystals were grown on a (LH) quartz surface in the presence of a molecularly (RH) oriented solution. Results obtained from the examination of these crystals found that the predominance in handedness usually exhibited by sodium chlorate when under the influence of a (RH) oriented solution, is significantly altered when also in the presence of a (LH) solid.

The conclusions that were reached from this original research have led to possible answers to the question of the formation of substances that can take both (RH) and (LH) forms. These results can further explain how the separation of (RH) from (LH) materials must have occurred far back in paleohistory inorder to reorient the naturally occurring levo-rotatory amino acids.

*Second Award - ISEF/Chemistry

A STUDY OF THE CATALYTICALLY INDUCED THERMAL REVERSION OF QUADRICYCLANE NORBORNADIENE: PHASE II

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The purpose of this project is to investigate the effects of various anhydrous transition metal salts on the quantitative conversion, purity, and thermodynamics of the thermal reversion of quadricyclane to norbornadiene. Although quadricyclane exists as a highly-strained molecule, it does not readily revert to norbornadiene without the addition of considerable amounts of the heat. Therefore, it becomes necessary to use an appropriate catalyst to initiate the conversion and release the energy in the molecule.

The catalysts $SnCl_2$, SnI_2, and $CuSO_4$ were chosen for their high reactivity, anhydrous nature, and insolubility with the solvent toluene. A calorimeter was designed and constructed to measure temperature change in the reaction between each catalyst and the quadricyclane in toluene. NMR and v.p.c. analyses were used to determine the structure, conversion and purity of norbornadiene produced.

$SnCl_2$ released the greatest amount of energy held in the strained organic ring-9.4×10^5 J and 8.8×10^5 J, respectively. The SnI_2 system released less of the potential energy, while $CuSO_4$ showed very poor capacity for the conversion process. No observable side products resulted from the isomerization, leading to the fact that the reversion proceeds with a high degree of chemical specificity. From this study, then, tin(II) salts show considerable catalytic behavior in converting quadricyclane to norbornadiene.

COCUS NUCIFERA LIN. AND *SACCHARUM OFICINARUM* LIN. AS SUBSTRATES IN MEDIATOR-INDUCED MICROBIAL FUEL CELL (MFC)

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An "unconventional energy" source called microbial fuel cell was produced in this study. It utilizes a biochemical system consisting of 2 "compartments" with corresponding carbon electrodes. In the carbon anode, mixture of the substrates coconut water/ cane sugar, *E. coli*, methylene blue and potassium phospate buffer which comprised the anolyte solution was placed in a dialysis membrane bag. The bag was inserted in a catholyte solution of potassium ferricyanide in potassium phospate buffer. The system was then connected to a voltmeter for measurement of electricity generated. The generation of anodic electrode potential was brought about by the oxidative degradation of the substrates by *E. coli* as active microbiological agent under the presence or absence of methylene blue which served as redox mediator. The efficiency of direct electron transfer between *E. coli* and the anode was measured by comparing the voltage output of mediator induced MFC and MFC without mediator. Statistical analysis showed a significant difference exists between voltage output of mediator induced MFC and control. The efficiency of MFC with mediator was almost 200%. The performance of coconut water and sugar as oxidizable substrates was compared with D-glucose since no significant difference exists among the three. An interaction effect exists between nature of substrates and kinds of treatment. Finally, MFC under efficient control can offer a way to offset the energy shortage in the Philippines.

#First Award - U.S. Department of Energy
Fourth Award - ISEF/Chemistry
Honorable Mention - American Chemical Society

THE SYNTHESIS OF AN L-ASPARTYL-L-PHENYLALANINE ETHYL ESTER

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Aspartame, discovered in 1969, is a dipeptide (L-aspartyl-L-phenylalanine methyl ester). It is composed of the amino acid, phenylalanine, aspartic acid, and methanol. Methanol, released during digestion, is toxic, dangerous, and may cause side effects as severe as blindness or cancer. In order to eliminate the release of methanol, an ethyl group was put in place of the methyl group. First, the ethyl ester was formed with phenylalanine by refluxing with ethanol. This solution was saturated with sodium chloride and then petroleum ether was added. The layers were separated. Then sulfanyl chloride and pyridene were added to the B-benzyl-L-aspartate and the layers were separated. The first solution was added to the latter solution and the benzyl group was removed with hydrogen gas. The new product should be an L-aspartyl-L-phenylalanine ethyl ester, a nontoxic form of aspartame.

To determine a preference, a known mass of sugar and nutrasweet were tested against water with laboratory mice. Because of a negative preference for the nutrasweet the new product was not fed to the mice. However, recent data revealed that L-aspartyl-L-phenylalanine ethyl ester is half as sweet as the methyl ester and one hundred times sweeter than sugar.

* CATALYTIC EFFECT OF THE CHLORIDE ION IN THE REDUCTION OF COPPER(II) ION BY METALLIC ALUMINUM

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The reduction of Copper(II) sulfate by metallic aluminum proceeds very slowly, no appreciable change can be observed within an hour. However, the addition of a small amount of chloride ion in the reaction mixture greatly enhances the reaction rate which is accompanied with an evolution of hydrogen. A similar catalytic effect can also be observed for other halide ions such as bromide and iodide ion, however in lesser extents. The dependence of the reaction rate on the catalyst concentration and the acidity of the solution has been investigated.

The aluminum metal has a fairly large reduction potential, therefore the reaction is thermodynamically feasible. However, the metal surface is usually covered with a thin oxide layer which hinders the reaction. The halide ion might be a bridge between alumium and Copper(II) ion to faciliate electron transfer.

*Honorable Mention - American Chemical Society

* LIGAND FIELD EFFECTS ON THE TRANSPORT OF 3D METAL (IONS ACROSS A BULK LIQUID MEMBRANE) BY LIPOPHILIC TETRAAMINE CARRIERS

Rubin, Bill, Arundel Senior H.S., Gambrills, MD 21054
656 Chapelview Dr., Odenton, MD 21113

No abstract received.

* Operation Cherry Blossom Trip - U.S. Army
First Award - ISEF/Chemistry
First Award - U.S. Army
Honorable Mention - American Chemical Society

CHEMICAL ANALYSIS OF MANGUIFERA INDICA L. FRUITS FROM TWO DIFFERENT ENVIRONMENTS

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The fruits of Manguifera indica or Mangos, original of the tropical asiatic countries are cultivated in almost every part of the island of Puerto Rico. The varieties Parvin, Haden, Davis-Haden, Irwin, Kent and Springfield consistently different in their gross weight, were collected at two different zones, Agricultural Experimental Stations of Juana Diaz and Mayaguez, P.R. Moisture, inorganic-organic components, soluble solids and pH were measured for each variety. Acids, amino acids and reducing sugars present in the pulp of samples were also recorded under standardized conditions.

It was shown that moisture content for each of the six varieties of the two environmental zones is 80%. A one gram content of combined inorganic-organic substance is shared by the mesophyticals Kent, Haden and Irwin, and the xerophyticals Irwin and Springfields. Hydrogen percentages in every case were in the range of 3 to 5 which suggest high acid content. Habitat and nutrient requirements of trees from both zones as well as statistics on crop yields are being determined to further justify the significance of these and other findings.

A TWO YEAR STUDY OF ORAL GALVANISM: PHASE II- ANALYSIS OF ELECTROCHEMICAL INTERACTIONS OF METALLIC ALLOYS IN VARIOUS MEDIUMS

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Oral galvanism is the generation of an electric current due to the corrosion of metallic restorations in the oral cavity. The ionization that occurs leads to disintegration of the metal and causes many harmful symptoms. An unpleasant or metallic taste is most distressful.

Phase I research determined the electric potentials of alloys exposed to artificial saliva. Phase II determined the electrochemical interactions of restorative alloys exposed to various mediums used to relieve an unpleasant or metallic taste. From previous research it was hypothesized that gold would again produce the highest electrical potential followed by chrome-cobalt, stainless steel, and amalgam, respectively. Secondly, the different elements in each medium would cause each alloy to emit varying electric potentials.

Each alloy was immersed into one of the four test solutions which were lactic acid, lemon juice, mouthwash, and tobacco. The alloy was then attached to the positive terminal of the voltmeter while the reference electrode was connected to the negative terminal. Electric potential (millivolts) was measured at five minute intervals up to one hour. Three trials were run for each alloy in the four test solutions. After experimentation, the control solutions were analyzed for element identification using plasma spectrometry.

Trial averages showed that chrome-cobalt produced the highest voltage when immersed in lactic acid, tobacco, and listerine while gold had the greatest electric potential in lemon juice. Overall, lactic acid induced the highest voltages emitted by the alloys. Using the standard voltage equation ($E^{o} = E^{o}\text{ox} + E^{o}\text{red}$) it was determined that disintegration of the metal occurred in each galvantic cell.

Photoprint Proof (a computer compatible fingerprint)

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Problem: The present day procedures in making a lifted latent fingerprint ready for computer scanning include: lifting latent fingerprint, photographing it, enlarging the photograph, tracing the fingerprint off of enlargement, photographing the tracing, reducing it, and then feeding it into a computer.

Purpose: To find a way of making a direct print from a lifted latent fingerprint that is compatible with crime computers.

Procedure: The new procedure of making a direct print includes:
1. Make a low sensitive emulsion from raw chemicals.
2. Place emulsion on paper.
3. Powder latent fingerprint and lift.
4. Place print on emulsion paper.
5. Expose to light.
6. Fix print from permanent storage and computer scanning.
7. Feed print into crime computer.

Conclusion: This process will produce a direct print of actual demension that is computer compatible.

Applications: Standardizing light intensity, photographic processes (photogram), direct print of lifted latent fingerprint.

#First Award - Eastman Kodak Company
Second Award - Society of Photographic Scientists and Engineers

#SUPERCONDUCTORS AND BARRIER LAYERS

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Thin film superconductors show great promise in production of microchips. Sol-gel is perhaps the superior method of manufacturing thin films. One problem during production is superconductor-substrate interdiffusion, i.e. atoms from the substrate diffuse into the superconductor and vice versa. This contaminates the film, lowering the temperature at which it superconducts (T_c). The purpose of this project is to devise a simple, inexpensive method to prevent interdiffusion. Barrier layers placed in between the substrate and the superconductor seemed promising.

I hypothesized that yttrium copper oxide would be a good barrier layer. From previous work I found it simple to produce by sol-gel. Diffusion of Y-Cu from the barrier layer into the active layer should be balanced by equal and opposite diffusion of Y-Cu from the superconductor into the barrier layer. Barium is a slow diffusing species, so interdiffusion is not expected to involve barium.

A barrier layer of $YCuO_5$ was prepared on a single-crystal Al_2O_3 substrate by sol-gel. This was coated with the superconductor $YBa_2Cu_3O_x$ by sol-gel. Uncoated Al_2O_3 substrates were also coated with $YBa_2Cu_3O_x$. The resistivity versus temperature was measured.

The superconductor with the barrier layer had an onset of superconductivity at 105 K while the sample on the Al_2O_3 with no barrier layer showed no transition.

My hypothesis was correct: the barrier layer effectively stopped interdiffusion between the $YBa_2Cu_3O_x$ superconductor and the Al_2O_3. Further studies were done on quantifying the effectiveness of varying barrier thicknesses using RBS and Auger spectroscopy.

#Alternate - U.S. Department of Energy Trip

COMPUTER SCIENCE

A PHOTOELECTRIC PHOTOMETER/COMPUTER INTERFACE

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The purpose of this project was to create an interface and related software, connecting the SSP-3 photoelectric photometer to the Apple][e computer thereby making it possible to do computerized differential photoelectric photometry. This allows the determination of the magnitudes of stars by comparing them to the known magnitude of another star.

The photometer outputs short pulses which are sent through the interface to the game I/O port of the computer. An assembly language subroutine counts the pulses coming from the photometer for one second. This value is stored in a location in memory and is used by the photometry program.

The photometry program uses the data gathered by the pulse counting subroutine to compare the brightness of stars with known and unknown magnitudes and calculates the unknown magnitude.

The interface is a very inexpensive and practical way of doing computerized photoelectric photometry. It is also a very valuable tool for research and observation of stars.

#PERFORMANCE MEASURES FOR EVALUATING RECONFIGURABLE MULTIPROCESSING ARCHITECTURES

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My investigation deals with technical issues associated with reconfigurable multiprocessing architectures. For this purpose, I constructed four identical processing modules and developed an operating system for interfacing these additional processors to my Apple II+ personal computer. I also created software for determining the relationship between: (*1*) Different types of computation intensive problems (summation of n integers, evaluation of polynomials of degree n, multiplication of nxn matrices, inversion of nxn matrices, and solution of a system of n equations in n unknowns). (*2*) Different computational loads, determined by the size of n, for each type of problem. (*3*) Different modes (sequential, using one processor; parallel, using two, three, and four processors concurrently) of computation. (*4*) Different programming languages (BASIC, C, Pascal). Computation time and memory requirements have been determined for evaluating the computational complexity attributed to the type of problem, computational load of each type of problem, parallel processing architecture, and programming language. Measures (speed-up factor, efficiency, and effectiveness of hardware/software system) for evaluating the design of parallel processing computer architectures have also been determined for their utility in trade-off studies. Simulation models of computation have been used for studying the effects of utilizing a large number of processors and extending the computational load. These models are validated with the actual computations for one, two, three and four processors, and the percentage error of simulation results estimated.
Important questions answered by my investigation include: (*1*) Is problem P_1 more computation intensive than problem P_2? (*2*) Does problem P have a better algorithm/architecture match using one processor or multiple processors in parallel?

#First Award - IEEE Computer Society
First Award - ISEF/Computer Science
First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society
First Award - U.S. Navy
Honorable Mention - Upsilon Pi Epsilon, The National Computer Science Honor Society

HEURISTIC ALGORITHMS FOR NAVIGATION IN ROBOTICS

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While J.R. I* was a prototypical success, its value in tight turning situations was questionable. As such, I found it to be of little use in heuristic maze negotiation experiments. A reformable situation: I removed the cover which sealed J.R.'s arm and circuitry and amputated the front portion of the vehicle. Improved feedback, a permutation of the arm, and a rerouting of its wires to modify turning completed the metamorphosis ... J.R. II.

Characteristic of many artificial intelligent programs is the fact that all their data is presented to them. In my experiment I attempted to supply the computer (program) with as little knowledge of an intensive subject (the maze) as possible, and have it attempt to "learn" heuristically - by trial and error - with little of no outside help.

I wished to avoid rote learning, simple memorization, so I devised a more complicated maze with wrong turns. When the computer interprets the robots feedback as a wrong turn, it must reclaim its saved data from the disk and backtrack. Nine successful turns is interpreted as the end of the maze.

Although I was - for the most part - successful, the cruces of the puzzle were comparable to last years: it's difficult with such rudimentary sensors to maintain and manage direction.

* Once again, J.R. denotes Junk Robot

Robotic Hand Control: Development of an Optical Computer Interface

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PURPOSE: The purpose of my project is to develope an optical interface by constructing and controling a robotic hand that can "see" the screen display and respond appropiately.
HYPOTHESIS: I think optical interfacing can provide an extremely flexible, yet economical means of controling hardware devices without the aid of conventional I/O boards.
PROCEDURE: Through my early experiments I found that it would be possible to control an external device with the computer screen graphics. The light from the computer screen is bright enough to activate an amplified light-sensitive relay. The photo-cell can be mounted on the computer screen. When light strikes the photo-cell, the relay is activate and the device turns on. This concept could be used instead of I/O boards, and one computer screen could control hundreds of devices. A device could easily be controlled by other computers. With I/O boards you need a different I/O board and a different program for each computer, but with an optical interface all you must do is change the program. To demonstrate my optical interface I built a robotic hand that is contonlled by the computer screen graphics. When light from the computer screen reaches the photo-cells, the solonoids are activated and the fingers respond.
CONCLUSION: It is possible to control a device using an optical interface and computer screen graphics. Optical interfacing could be used for many different devices. A light could be controlled by the computer and could be dimmed by the amount of light from the computer screen. The computer could control hundreds of devices at the same time. A device could be controlled with every pixle on the screen.

THE USE OF AWARD AND DENIAL FACTORS COMBINED IN A NEURAL NETWORK IN A PROBLEM-SOLVING COMPUTER PROGRAM

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The purpose of this project has been to develope a computer program that is capable of analyzing data from its base, allowing it to provide correct responses for identification type problems. Three ratio formulas were developed that increase the accuracy of solving identification type problems to a 70-99% preformance level, depending on the diversity and completeness of input. One ratio serves to augment significant data to give it a greater point value in favor of the correct answer, while the second and third ratios serve to reinforce the first by penalizing less probable or significant data that is not a characteristic of the correct response. The program "learns" correct responses by the user evaluating its preformance by either rewarding for a correct answer or penalizing for an incorrect one. As information is processed, the set of data which is labeled symptoms, that scores the most points is then matched to the correct catagory. Statistically, this was tested against a conventional program without these ratios present, and the results show acceptable scientific significance, using a T-test as the basis of analysis. Application of this program is made to a biological identification problem of matching symptoms of a viral infection to the correct virus. Its proven value here has applications in medical fields worldwide, such as an emergency service where a physician is not present to highly specialized care where a doctor has the benefit of immediate feedback. Other applications will occur wherever identification type problems are present.

HELPING HANDICAPPED PEOPLE COMMUNICATE WITH OTHERS

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The purpose of this project was to find a way that handicapped people who cannot speak, write or type could communicate with others through the use of a computer. Their needs and wants could be expressed and lives enhanced through this communication. This project was carried out in five phases:

1) Develop the computer program.
2) Determine what voluntary functions a handicapped person might have, and make switches for each of these functions.
3) Research the different ways that a computer could output the handicapped person's message.
4) Test out the program and switches in a controlled environment.
5) Test the program on a handicapped person.

Programs were developed that enabled words to be formed by choosing letters from columns. In one program, the letters were arranged alphabetically or by putting the most commonly used letter close to the dot. Another was made to put words on the screen.

Some additional programs were developed so people could practice using switches and the computer. Touch switches, a sound switch, and a breath switch were developed. A model was made to show how an eye switch would work. A joystick was made for those with limited hand movement. Program users were able to communicate by outputting messages on the screen, printer, and a voice synthesizer.

This research proved that a computer could be used by handicapped people to communicate with others.

Through the use of a modem, handicapped people could communicate with others by telephone.

#Honorable Mention - American Speech-Language-Hearing Association

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#DEVELOPMENT OF AN ARTIFICIAL INTELLIGENCE COMPUTER MUSIC COMPOSITION SYSTEM

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This research utilized two experiments designed to determine (1) if computers can efficiently compose aesthetic Baroque music and (2) if computers can compose creative, more complex, and emotional music. In First Year research, this experimenter developed a computer system which composed music by applying fundamental counterpoint and harmony composition rules. These compositions were determined by professional musicians to be concordant and generally aesthetic. In Second Year research, a technique was designed to compose more emotional, complex, and creative music by simulating the interaction of neurons in the brain. The neural network program utilizes a nine million neuron matrix, whose complexity prohibits execution on existing computers. Advances in super neural computer technology should allow execution of this program within two years. The significance of this work to mankind is that it may help to further knowledge of music and musical composition, of creative thinking processes and brain functioning, and of limitations and applications of neural networks. This research is essential for the evolution of computers from "expert" systems and artificial intelligence machines into more humanlike devices which can learn, reason, create, and literally think.

#Second Award - Sigma Xi, The Scientific Research Society
Third Award - ISEF/Computer Science

ORACLE: THE BIRTH OF AN EXPERT SYSTEM

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An expert system is a computer program which can solve problems and make decisions like a human expert. It does so by using the knowledge of human experts and by being able to reason with such knowledge. At the heart of every expert system lies an expert system shell, which is a group of subprograms that essentially form the reasoning capabilities of an expert system.

In this project, an expert system shell, ORACLE, was created and used as a framework for ORACLE-based expert systems. ORACLE is a fairly complete expert system shell with a full range of reasoning capabilities, and for this project it was used to build two expert systems, XPERTS, an expert system on commercial expert system packages, and Access, an expert system on computer data sorting and hashing algorithms. ORACLE and its expert systems satisfy most of the criteria for expert systems and match up to many modern expert systems available on the market today.

#First Award - Association for Computing Machinery
First Award - Federal Aviation Administration

A new algorithmic Search Technique That Maximizes Efficiency

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A computer program was written that searches for a particular piece of numerical data on an ordered list. Using proportions, the program estimates where the number will be. If the number is not found, a new proportion is created and the routine re-estimates where the number will be.

The program was then compared to the Linear search and the Binary search using lists of different lengths and using different equations to create the lists. Each search routine was run on each list, and the average number of comparisons required for each routine to locate the numerical data, as well as the largest number of comparisons for each, were recorded.

With both the Linear search algorithm and the Binary search algorithm, the length of the list was the only variable that affected the number of comparisons. In these cases the shorter the list, the more efficient the search.

The new algorithmic technique, since it uses proportions, was relatively unaffected by the size of the list, but was greatly affected by the list itself. If the list was skewed, (unevenly dispersed) then the search was less efficient. In evenly dispersed lists, the new search algorithm was very efficient.

In conclusion, the new search algorithm is more efficient than the Binary search and the Linear search if the list is evenly dispersed, but is less efficient than either search algorithm if the list is greatly skewed.

Natural Language Processing

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The purpose of this project was to create a computer program capable of absorbing information given in an English sentence, and then answering questions about that information. The program is written in C. It somewhat follows the pattern of a re-write rule parser, but has several distinctions from a normal re-write rule parser. One, it generates a grid structure, instead of the normal tree structure. And two, the rules it uses are more complicated, and a little "smarter".

A DYNAMIC SIMULATION OF A BALLISTIC MISSILE DEFENSE

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A dynamic computer simulation of a space-based laser ballistic missile defense (BMD) system was performed, over a two year period, to study the factors which influence a BMD's performance against a variety of possible offenses. This simulation was highly realistic, in that it took into account many factors, such as the curvature of the earth and mobile missiles, not accounted for in other models. Using a VAX to run the simulation, over 21,000 unique scenarios involving combinations of various realistic offenses and defenses were examined.

The simulation modeled the trajectories of the incoming missiles, following them through their boost phase and performed a second by second calculation of their destruction as they attempted to reach their targets, which included US missile silos and heavily populated cities. Satellites were allocated for optimum performance using an algorithm which determined the best satellite to destroy each particular missile.

The resultant data were plotted and analyzed, and a theoretical curve was fitted to the simulation data. This curve was a new "square root scaling" relating the number of BMD satellites and the number of missiles destroyed. From this relation, the number of satellites needed for such a defense was determined for possible present and future laser technology. For the specific BMD systems studied, SDI was found to be practical only if laser technology advances to a level much more sophisticated than presently exists.

*Scholarship - U.S. Marine Corps
Third Award - American Astronautical Society
Third Award - ISEF/Computer Science
Honorable Mention - Upsilon Pi Epsilon, The National Computer Science Honor Society

# VOICE RECOGNITION

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The ability of a computer to recognize human speech would result in an increase of data entry speed by four to ten times. It also has a tremendous market potential. Currently, two major forms of speech identification exist: hardware processing and software recording.

Hardware processing is the fastest form of recognition. This form uses integrated circuits to identify and analyze voice patterns. However, the hardware method has a limited vocabulary and its flexibility is sacrificed for speed. The software method is not a true form of voice recognition. This method uses software to record the speech patterns and then matches a second pattern to the original. This method requires a monotoned speech pattern and is not accurate. However, a larger vocabulary may be used.

The method developed in this project uses a hybrid of hardware and software recognition. The hardware (analog-to-digital converter) translates the voice into numbers. The software then performs a Fourier analysis on the data to correlate them with a set of preprogrammed allophones to identify the voice.

*First Award - Acoustical Society of America
Third Award - ISEF/Computer Science
Honorable Mention - National Aeronautics and Space Administration

DESIGNING THE ULTIMATE COMPUTER LANGUAGE : PHASE III

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The Micro Supercomputer is the third part in a five year project to design the ultimate computer language. In order to do this, it was necessary to define what "ultimate" really means. I have defined it as the highest average in each of the followin four categories:

1. Ease of Use
2. Universality
3. Power
4. Expandibility

Ease of use id defined as how easy a particular language is to use. This category also includes documentation and screen layout.

Universality is how close a particular language comes to being compatible with current industry standards. This category can also include the ability to work with other machines.

Power is determined by the number of features and user-definable traits a language has. This category also includes speed, flexibility, and misc. features.

Expandibility is the ability to change and adapt to the users specific needs.

In the fifth and final year of this project, I plan to combine all of these features into one single language. I also plan to use this language in a scientific test to determine whether or not I succeeded in designing the ultimate computer language.

ARE TODAY'S ROBOTS FASTER YET STILL MORE ACCURATE THAN THE HUMANS CONTROLLING THEM

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The purpose of this project was to find out if today's personal computers can be programmed to control a robot arm faster and more accurately than human operators. This was achieved by a Pascal programmed robot racing a human to move a block from one randomly chosen point to another.

I hypothesize that if programmed properly, the computer controlled robot arm would be swifter and more accurate than a human.

Fifteen humans (age 14-16) raced against the computer controlled robot a total of sixty times. Three beginning and ending points were determined randomly by the computer. These points were used by both computer and humans. The time in seconds, accuracy in cm, and distance between points in cm were measured.

The results showed that the humans were more accurate. The computer controlled robot arm tended to be less accurate at speeds the humans could attain. The robot was unable to identify and correct errors in movement. Humans could correct even slight mistakes easily.

The results lead to the conclusion that it wasn't the computer program at fault, but the hardware and its lack of feedback sensors. Because the robot motors often slipped when running, slight inaccuracies added up. These inaccuracies were not identifiable or correctable by the robot because it lacked sensors. Therefore without the proper hardware (sensors), no program I could have written would have been able to correct these inaccuracies.

*AN EXPERIMENT IN ARTIFICIAL INTELLIGENCE: THE COMPUTER ANALYSIS OF GEOMETRIC SYSTEMS

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The original purpose of this project was to design a computer program which would take information about a geometric system, determine other facts about the system, and construct proofs of these facts.

I selected the artificial intelligence language Prolog for this program, and designed Prolog predicates to implement geometric theorems and construct proofs. I also developed a user-friendly environment for these theorems to facilitate their use.

While translating geometric theorems into Prolog, I saw that some theorems required special techniques for their implementation. Many of these theorems were recursive, that is, they referred to themselves in their definitions. Another difficulty was the construction of written proofs. I found that the techniques that solved difficulties for one theorem could be employed to solve difficulties in another. In fact, these techniques were applicable to nongeometric theorems. Furthermore, the procedure for constructing the geometric proofs could be used to construct any proof.

In conclusion, what began as an attempt to program a computer to analyze geometric systems evolved into an experiment in artificial intelligence, and the techniques used to develop this program have substantial implications beyond the original problem.

*Fourth Award - ISEF/Computer Science
Honorable Mention - Association of Computing Machinery

COMPUTERIZED PLANETARIUM

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A planetarium is a device which displays stars on a domed ceiling as they would appear in the night sky. It follows, then, that this device could be emulated on a computer. This project was designed in an attempt to allow anyone to view the stars in the sky as they would be seen at any moment in time and at any location. Its main purpose is as a teaching aid to the novice astronomer. Several functions were designed to find star names and positions and to display constellations. The coordinates of almost all stars visible to the naked eye on a clear night (962 stars up to magnitude 5.5) were typed in along with forty constellations. The computer planetarium allows viewing of either the northern or southern horizon. Stars of different brightness are represented by different dot sizes.

This computerized planetarium is written in Turbo Pascal. Formulas for the northern and southern horizons were found in "Nibble" magazine in a basic program titled "Nibble Planetarium," and the formula for computing sidereal time (sidereal time corresponds to the Earth's orbit and runs several minutes slower than solar time) was found in "Astronomy" magazine. Both program segments were translated from basic to pascal.

# KAT: A NEW LANGUAGE, COMPUTERS VI

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It was found that LOGO was very difficult for beginning programmers. From past projects, it was found that LOGO was part of the problem rather than part of the solution. A more user-friendly language could be developed.

It was decided that testing the finished language could reveal what was needed to make KAT more user-friendly.

KAT's structure had to be changed, and many primitives added before testing could be started. Tests were then developed and given to diffferent age groups. The initial testing revealed that a few improvements were needed. KAT was expanded to include the needed improvements.

Final test results indicated that KAT could do all the things LOGO graphics could do, only faster, easier, and much more logically. KAT had an average 67% programming time savings over LOGO and a 94% time savings to teach the language.

By testing an early version of the completed language, it was found that some enhancements were needed to make KAT easier to use than LOGO. After these additions, further testing revealed that KAT does dramatically increase the programmer's efficiency.

Just as human languages have evolved to fit the needs of particular groups of people, so have computer languages been tailored to different functions. KAT's ability to erase, delete, and save as a person programs is very important in program design simply because the overwhelming majority of programs fail the first time. KAT has been tailored to make graphics progamming fun and easy for all. To sum it all up, "A picture is worth a thousand words."

#Fourth Award - ISEF/Computer Science

AUTOGENOUS PROGRAMMING TECHNIQUES-Applications in Artificial Intelligence; Implications for Data Integrity

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The purpose of this project is to determine the advantages that self-modifying programs have over standard programs and to determine if these advantages could make self-modifying programs a more effective defense against "virus" programs than standard programs.

First, a method was worked out by which a computer could give itself commands and alter its own programming. Next a short group of programs was written to determine some things a self-modifying program could do. In order to write the anti-"virus" program, a simple virus had to be written. Then the anti-"virus" program was written.

It was determined that self-modifying programs, in certain cases, are smaller, faster, and more convenient to use than their standard counterparts. Self-modifying programs can also do many things that are difficult or impossible to do with standard programs. The anti-"virus" program effectively protected the system against the virus it was written for. However, it cannot defend against all virus programs.

#THE IMPLEMENTATION OF COMPUTER PACKET NETWORK INTERFACES. PHASE TWO

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This is the second phase of a project that I have been researching for three years and which explores many different aspects of dial-up telephone networks. In phase one of this project, a network interface was written which allows the **Hewlett-Packard** 150 to communicate with an international dial-up computer network called **FidoNet.** This network provides for the exchange of information between different kinds of computers. In the current phase of the project, the effects of different information transfer protocols and network lay-outs (topology) were studied. An information transfer protocol is an agreed upon standard for communication. I have written an additional network protocol to make the entire information transfer protocol between the computers more robust. Also, I wrote a network gateway to interface two networks that would otherwise be incompatible. The gateway allows for the flow of information between different kinds of **networks.** This new network gateway offers the ability to study and compare the topologies of two different networks and to learn the strengths and weaknesses of each.

#Second Award - ISEF/Computer Science
Second Award - U.S. Air Force

AN IMPLEMENTATION OF AN INTEGRATED SOFTWARE DEVELOPMENT SYSTEM TO INCREASE PRODUCTIVITY

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Over the years, the cost for software development has increased dramatically. One of the major reasons for this increase in the cost for software development is due to the rising cost for hiring programmers. As our society becomes more and more computerized, the demand for new software has increased and the problem with the increasing cost for software has become absolutely critical since it can have a substantial impact in our economy. However, most existing software development packages tend to decrease the productivity of programmers since these packages are very inflexible and they lack the support for modern computing. My integrated software development system entitled "The Software Department" (TSD) is designed to solve the problem by providing powerful and ease-to-use tools to increase the productivity of the programmers.

This system includes intelligent editors, code generation utilities, support for network computing, desktop utilities, on-screen programming reference, a natural computer language, and many other programming utilities. It is based on an open architecture which allows users to attach their own application programs as well as new TSD modules to the system. By providing all these tools and flexibilities, users can expand and customize the system to fit their needs so their productivity will be increased and the cost for software development will be decreased.

So far, satisfying results have been obtained at the alpha and the beta testing of this system. More research and development are still being conducted which include new programming utilities, new desktop utilities, and programs for supporting the planning and the documentation stage of software development.

#First Award - U.S. Air Force
Honorable Mention - Association for Computing Machinery

COMPUTER SIMULATED NEURAL NETWORKS

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It is well known that biological systems of neurons possess unique and powerful computational abilities. Through the use of computer simulations, systems of neurons have been constructed digitally. The abilities of these simulated neural networks are quite similar to those of their biological counterparts. The Hopfield Model neural network has been simulated for an analysis of its use in content-addressable memories. The collective properties of this neural network yield a content-addressable memory which correctly outputs an entire memory when supplied with an input of sufficient accuracy. An improvement to the Hopfield Model, developed by Macukow and Arsenault, modifies the threshold condition of the model, improving its accuracy. The pattern recognition application devised and written by the researcher uses a system of two-dimensional arrays of neurons and a four-dimensional connection matrix. All systems of neurons are dynamically allocated as to enable flexibility in choosing the number of neurons in the system. This network will output an accurate recognition when supplied with an adequate number of correct neural inputs. The program is also able to save images and connection matrices to disk, enabling future investigation and experimentation. In addition to content-addressable memories, neural networks can also be used to solve a variety of optimization problems. A number of learning rules, enabling the networks to learn from both user inputs and experiences, have been implemented and are currently under experimentation. It is hoped that both the pattern recognition abilities and the learning rules' problem solving capabilities can be integrated into a single application. The study of the inherent computational abilities displayed by the highly interconnected neural networks may indeed be a step towards the understanding of our own personal neural network, the human brain.

A COMPUTER SIMULATION OF BIOLOGICAL EVOLUTION

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The purpose of this project was to create a computer program to simulate biological evolution. Evolution is an occurrence in nature where over long periods of time a given population can evolve into a population with different kinds of organisms. In the 1800's many theories were developed to try to explain why evolution occurs. The theory most widely accepted today is Charles Darwin's theory of evolution: Survival of the fittest. The program developed in this project did not try to determine "fitness" on an individual basis. The determination of the more fit organisms was achieved by predators and prey competing for space in a world of a few thousand locations. The competition in this ecology was implemented by giving each organism a chance to move and reproduce in the belief that the fitter organisms would survive. An organism would die if it starved, was eaten, was overcrowded or was too old. How and what each organism did was determined by twelve traits, including: expected life span, reproduction cycle length, movement cycle length, need cycle length, sensory level, etc. Each organism had two chromosomes of twelve genes that combined with varying dominances to form the organism's traits. When offspring were produced, the genes could mutate by point mutation and/or crossover mutation. The mutations were randomly done, allowing traits to mutate in either direction. After running the program for several weeks, the organisms' traits changed towards more favorable values. These changes support that the program has succeeded in simulating evolution.

NATURAL LANGUAGE PROCESSING

Fulton, Truxton
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Natural language processing (NLP) is a process by which ideas conveyed in natural language form (English) are converted into computer understandable form. A natural language processor is the basis for an adaptive computer system that is useful to an ordinary person with no background in computers. The applications of this process include: interfaces to databases; natural language translation (from one natural language to another); text scanning programs for summarizing large amounts of text; and speech systems to allow voice interactions with computers. At present there are about five accepted approaches to parsing. They are: pattern-matching; grammar-based; semantic; knowledge-based; and neural-network parsers. The approach I have taken is conceptually similar to the pattern-matching and grammar-based parsers. The parser I developed does not have a concrete set of patterns to match with incoming sentences: however, the number of possible sentence constructions it is capable of analyzing is indeed finite. It differs from a grammar-based parser by the way it approaches words; a grammar-based parser deals strictly with the different phrase catagories into which a set of words falls. By looking at the word's possible parts of speech, and its juxtaposition in the sentence, each word's role in the sentence is determined. Words in the sentence may have more than one possible part of speech: for example, "drink" can be either a noun or a verb. In dealing with this, my program will process all possible usages and eliminate those which cannot combine with the rest of the sentence to form a recognizable structure. My program then produces both a textual and graphic parse of the sentence.

#First Award - American Indian Science and Engineering Society
First Award - Upsilon Pi Epsilon, The National Computer Science Honor Society
Second Award - ISEF/Computer Science

THE LIE DETECTOR

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This science fair project is based on a program and a circuitry resistance unit that is used to determine whether a person is lying or telling the truth.

The purpose of this experiment is to determine whether a subject is telling the truth or lying by use of an easily home engineered lie detector.

The procedure involves use of a home Atari computer system that uses a program I wrote to graph and output results to visual and text from the testing session. The second part of my procedure involves making a circuitry resistance unit that sends five volts of electricity through a person and then sends the amount of conductivity to the computer where it is changed to decimals and then graphed and printed.

As a conclusion I have determined that a home lie detector can be made through the use of a home computer and a few easily found "extras". The lie detector proved to be a success at 87.5 percent accuracy in telling the difference between a lie and the truth but there were a few places where the subject fooled the computer which can be expected in any lie detector .

# COMPUTERIEZED THREE DIMENSIONAL GEOMETRIC OBJECTS

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ZYPHRUS is a computer program I wrote to create, manipulate and display three dimensional geometric shapes. The geometric objects are defined by x,y and z points connected by lines forming polygons. Each polygon makes up a side of the object. Since the objects are made up of specific x,y and z points, it is possible to manipulate them via mathematical formulas allowing for rotating, twisting and sizing of the objects.

Many things may be done with ZYPHRUS. The editor allows one to examine the objects from three different views (front, top and side), making it extremely easy to enter x,y and z coordinates through the key board or mouse to define vertexes of polygons. The viewer is the heart of ZYPHRUS, allowing one to move in any direction around the object, almost as though one were filming with a camera. The object may be magnified, twisted, or rotated. One also has the choice of many colors. The object may also be made a solid. To capture the look of a real object, light reflection has been implemented. This light reflection gives the object the appearance of a light shining upon it. This light source may be moved anywhere in a three dimensional space giving the object the touch of realism.

ZYPHRUS is the result of twelve months of original programming on the Commodore Amiga computer. The program was written in Amiga Structured Basic and is 1,419 lines in length.

#Second Award - Patent and Trademark Office/U.S. Department of Commerce/Patent and Trademark Office Society

# COMPUTER COMMUNICATIONS SECURITY

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Computer Communications Security plays an important role in computer data communications. Important information cannot be transferred from one source to another with standard protocol without allowing unwanted persons to receive the data. In solution to this problem, non-standard protocols can be designed to transmit and receive data. This project demonstrates such a protocol. First a mock transmission environment was created with six channels and two clocks for serial communications. The clocks eliminated a need for interrupt driven buffering which would have posed a difficult project in itself. The transmission operating system designed allowed the data rate and channel to be switched quickly. Second, a protocol was designed that made efficient use of the transmission environment. The protocol switches channels upon each successful transmission block. The protocol also has error checking ability and sends its status resend or OK for each block. Data rate, scrambling routine execution pointers, checksum routine execution pointers and sync bytes are also changed upon each successful transmission block. The protocol has an 18 byte header block and a 256 byte data block as well as two checksum bytes. The routine uses multiple checksum algorithms, as well as multiple scrambling and descrambling algorithms. Checksum and scrambling routines were executed according to a random bit pattern put into the header block by the transmitting computer. This project demonstrates a non-standard transmission protocol with a very unpredictable transfer pattern. In conclusion, the protocol designed was tested and is able to send data securely and efficiently.

#Honorable Mention - Federal Aviation Administration

*DEVELOPMENT OF COMPRESSION TECHNIQUES FOR THE EFFICIENT STORAGE OF DATA

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I have developed programs that compress data in a computer. Data compression reduces the physical size of a data block without losing any actual data. In the future, computers will need to be able to store and access more data. Data compression can perform this without adding additional storage space. Almost any computer user can benefit from data compression. I, like many users, have a large library of software and I always seem to run out of disks. Using data compression, I found that these software programs could be compacted to make more efficient use of the disks. This freed up some of my disks for other use. There are many different methods of data compression. After studying various data compression programs, I have found that some methods compress more than others and some are faster than others. I have written programs to demonstrate and test the efficiency of some forms of data compression. Some of these techniques were developed through research into another's work, while others were developed by analyzing the results of other methods. Many of these techniques are very sophisticated and writing them was a very involved and complex task.

*Third Award - IEEE Computer Society
Fourth Award - ISEF/Computer Science

How Could The Quadriplegics Use the Computers

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The use of the periferal adapted to the computer demonstrated its efficiency to be used by quadriplegics.

Using a computer, some cables, four interruptors and some metal easy to mold and light, in this case aluminum, it was possible to build an instrument that will benefit persons that have the condition mentioned before.

Actually, this instrument could be used in the Commodore 64 Computer. If we use it in other computers, it will not work. Some modifications in the system and some changes are necessary to be able to utilize it. The programs used are made in Basic 2.0. Making changes in the programs and making new programs will get better use of the periferal.

When the interruptors are pressed individually the current goes to the port and we obtain a different value from each interruptor in the location 56320 of the Computer. These values are the base to prepare the programs.

Using this periferal as the base to realize modifications and perfecting it, the quadriplegics will find an easy way to use the computer for professional work or only for entertainment.

ARTIFICIAL INTELLIGENCE: APPLIED TO A GAME

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Four Tic-Tac-Toe programs of varying "intelligence" levels were designed on the IBM Personal Computer to play against human opponents. The "intelligence" of the programs varies from the basic level where only the "rules of the game" are known to the program, to the fourth and most advanced level where the program looks several moves ahead to determine the most optimum move. At the second and third levels the optimum move is based on an assessment of the "current" situation of the opponent relative to the computer's, except that at the third level the optimum move is also determined by dynamically adjusting a "coefficient of aggressiveness" for a particular opponent in a given session.

Eight subjects played a series of games against each of the four programs. The win/loss percentage against each of the eight subjects was plotted for each of the four programs. On an overall basis, the level four program performed best, and as should be expected the win/loss percentage increased progressively from level one to four. The programs have been written in Pascal.

COMPUTER BASED IMAGE UNDERSTANDING USING ARTIFICIAL INTELLIGENCE

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My purpose was to create a knowledge based character recognition system using feature analysis to enable the computer to read and understand handwritten characters. I scanned a wide range of handwritten characters designed to include many variations in style and used these as my input to test the system. My data was designed to include ambiguity in an attempt to confuse the program. It also included various stroke widths, positioning, and slants as might be found in actual handwriting. After tests on almost 200 images, the program's success rate was 98.5%. After modification the program is now successful in identifying digits 100% of the time. I concluded that, within certain limits, a computer can be taught to read and understand handwritten characters using Artificial Intelligence. This is best accomplished by simplification of the image, just as the human eye does, and analysis of its primitive features. The technique of character recognition by feature analysis allows for recognition of handwritten characters independent of their style or dimensions at a level of accuracy much greater than other techniques like pattern and template matching. In the future I plan to continue and expand my study of Artificial Intelligence. I have already followed up this project by generalizing what I have learned about feature analysis and applying it to the study of the graphic rendition of faces. I have started this second phase of my research by designing several modules of a face recognition program.

*First Award - National Aeronautics and Space Administration
First Award - Patent and Trademark Office/U.S. Department of Commerce/ Patent and Trademark Office Society
Forth Award - ISEF/Computer Science

# NEURAL STRUCTURES FOR LEARNING (A TWO-YEAR STUDY)

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Neural networks, groups of interactive processing units based on human brain cells, have traditionally been connected in uniform patterns; a six-neuron uniform network was used when this project began last year. These networks yield good solutions to some problems, but at others they are inadequate. Further, studies of mammalian brains show that the neurons are not all arranged in uniform patterns, but are often connected in specific structures. Facts such as these led me to develop new techniques of network architecture for the second year of this project.

A small environment was simulated on an Apple //e computer, and an icon was guided through this environment by a neural network. The design of this network was the focus of this year's project; primary goals were a fast learning capability and perfect retention. These goals were met through the development of specific learning structures such as memory units, a second-level input processor, and object recognizers. The current sixty-one-neuron network has the capacity to learn to distinguish among four different objects, expandable up to the memory limits of the computer; it learns from experiences (for example, bumping into a wall or eating food) instantly and remembers perfectly. The greatest value of this project, however, comes not from what the network can do, but how the network does it. The high goals set for this year forced me to develop new techniques in network design, such as the "stable" and "competitive" groups. These are general-purpose structures that will have uncountable applications in future network designs.

*First Award - U.S. Army

QUANTIFYING NONCLASSICAL RACIAL STABILITY FACTORS

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The classical explanation of the formation of new races has three parts. There must be migration and isolation of a small population segment, followed by genetic drift or mutation and natural selection, finally followed by remingling and hybridization. Unfortunately, this explanation is somewhat flawed. For instance, we now know from recent genetic research that remingling and hybridization should result in a race of uniform color. This is not observed.

I hypothesized that a "racial preference factor" might be an important nonclassical variable in reconciling theory and observation. This, three other nonclassical variables, and three classical variables were studied using the Monte Carlo simulation technique. The use of all integer arrays, pseudo random sampling, and preset neighborhood search patterns allowed sufficiently rapid execution to simulate 20 generations in 16 seconds.

Introduction of a "racial preference factor" led to dramatic changes in racial stability. Considering the survival of derivative forms, survival time jumped from 3 to 12 generations when the "racial preference factor" was increased from 0 to 1. The model was tested by simulating standard variations, and in every case the expected results were found.

By simulating population dynamics on a personal computer it can be shown that new subspecies have a far better chance of surviving than was previously thought possible. This finding is consistent with the rich diversity of races that populate our world.

#First Award - Sigma Xi, The Scientific Research Society
Fourth Award - ISEF/Computer Science

SMART COMMUNICATIONS

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PURPOSE: To write a program that enables the transferring and translating of graphics, sounds, text, and other data between two incompatible computers (Atari and Amiga) using a custom cable to connect the two computers. To make the software flexible so that maximum speed and verification is used in the input/output, and also to allow the program to easily adapt to other incompatible computers.

RESEARCH: Use the technical reference manuals for each of the incompatible computers to find ways to link them together in graphics, sounds, text and other ways.

PROCEDURE: Use the custom cable and the prompts given by the software to do input/output between the two computers. (The software is completely self-explanatory.)

DATA: After using the program, the following can be noted: communication speeds range from 1000 bauds to 9000 bauds, graphic and sound conversions to Amiga have 0% distortion, graphic and sound conversions to Atari have 12-16% distortion, and text conversion has 0% distortion either way.

CONCLUSION: All input and output is done perfectly. The software could be extended to include other incompatible computers such as IBMs and Apples.

APPLICATIONS: Easier to upgrade to a new standard, saves millions of dollars for companies writing software for many types of computers, and bridges the gap of incompatibles.

#Honorable Mention - Upsilon Pi Epsilon, The National Computer Science Honor Society

#OBJECTIVE ANALYSIS IN WEATHER FORECASTING: A THREE-YEAR STUDY

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This project was done to determine if a student developed, multiple computer, automated weather network utilizing artificial intelligence, objective analysis, and numerical modeling would increase the accuracy of the system compared to other methods and systems.

The project was conducted by first researching the concepts used in the project, improving the gathering system, and creating a second network system. From this data, a network was developed using two computers: one acting as a weather gathering station and the other acting to collect, analyze, and compute forecasts for the network. The network operated on data that it obtained from September 1, 1987 through January 15, 1988. U.S. Weather Service forecasts were obtained for the same period. In addition to the experimental period, the network produced extended period "intelligent" forecasts for prior experimental periods. The accuracy of the "intelligent" forecasts was compared to that of the present U.S. Weather Service, 1955 Weather Service, automated forecasts, and computer assisted forecasts.

Overall, the most accurate forecasts were the "intelligent" one day forecasts which were 93.9% accurate. The other accuracies are: "intelligent" two day--81.8%, U.S. Weather Service one day--90.6%, U.S. Weather Service two day--76.8%, automated computer forecasts--93.3%, computer assisted--83.6%, and 1955 Weather Service--61%.

As variables effecting weather conditions are better understood and recorded, computers will enable these to be analyzed quickly to provide very accurate forecasts over extended periods of time. This will result in substantial effects on social and economic conditions in the world.

#Second Award - Federal Aviation Administration
Third Award - ISEF/Computer Science
Honorable Mention - American Meteorological Society

SHORT TERM MEMORY

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This project consists of two parts. Part I was to design a program to determine one's short term memory, or the length of time five letters must be seen to be recalled. Part II was to use this program to test the hypotheses: that there would be a great difference between the short term memory levels of different age groups and little or no difference between the short term memory levels of different sexes. After completion of the program and collecting of data I found that a computer program could be designed to measure one's short term memory. A distribution was observed, but there were not enough subjects to make reliable conclusions. Therefore, I will continue to collect data throughout the science fair. This program may be useful to Navy employers who are taking applicants for heliograph operators on Navy ships. Foremen in manufacturing, who are taking applicants for assembly line workers, could also use it. In the areas above, the short term memory program could be used to see which applicants are better suited for a job in that field. If the program were equipped to randomly choose a group of letters in progressively shorter times and with repeated and prolonged practice, it could also be used to enhance the short term memory of workers in either of the fields above.

HENON MAPS: A WINDOW INTO CHAOS

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I conducted a study of CHAOS by using Henon Maps. A Henon Map is an area preserving map of the plane given by the equations:

$$X_{(n+1)} = X_{(n)} * \cos(A) - [Y_{(n)} - (X_{(n)})^2] * \sin(A)$$
$$Y_{(n+1)} = X_{(n)} * \sin(A) + [Y_{(n)} - (X_{(n)})^2] * \cos(A)$$

where A is the phase angle.

The purpose of this study was to investigate Henon Maps, to study the new science of CHAOS using Henon Maps and Henon's Strange Attractors to research the dynamics of complex systems. I made Henon Maps for every phase angle between 0^{o} and 360^{o} at 1 degree increments. I found phase angles where Henon Maps show stable resonance bands, and established the phase angles at which Henon Maps show acute instabilities. I also observed which angles give Henon Maps with stability islands. I used Henon Maps as a tool for Computer Science and Engineering and produced a Henon Map Benchmark for measuring computer speed. I evaluated several computer systems with and without Math Co-Processors using this benchmark. I also explored Computer Cinematography by making Henon Movies.

This project was largely based upon the information provided in the article by Gordon Hughes "HENON MAPPING WITH PASCAL", published in BYTE (Dec. 1986) and James Gleick's new book "CHAOS: MAKING A NEW SCIENCE". I entered the Turbo Pascal program from BYTE and modified it into several different versions. In one version, I replaced the original Henon Map equation with the Henon Strange Attractor equation to model Saturn's rings. Henon Map images were stored using the program: PRESENT52 and then played back at high speed to make Henon movies. That gives a great opportunity to see changes in the Henon Maps with slight changes in phase angle. I also made a Computer Monitor to Camera adapter and photographed the Henon Maps in color for detailed studies.

EARTH AND SPACE SCIENCES

NONTYPICAL FUEL SOURCES

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My project is an earth and space science project. I tested uncommon fuel sources to see how long they would burn and to what degree. I did some research to see how commercial logs were made. I found they were held together by wax. What I burned was compacted logs until I realized the wax was giving heat to my source. I started burning my samples in a fireplace made out of a 5 (five) gallon can. I then built a calorimeter and furnace so I would be able to calculate calories. I now have built a new stove that has proven to be more accurate. In my stoves I burned tree leaves, christmas trees, thistles, corn stalks, nut shells, sunflower seeds, peanut shells, manure, straw, pine cones, coal, orange peels and paper. In my new stove I was able to calculate accurate readings of calories and heat of combustion. I used a flow meter to regulate the flow of air into the burning chamber.

COMPARATIVE CRATER PROPORTIONS ON THE ICY MOONS OF SATURN

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In this project I compared the average depth to diameter ratio of impact craters on three of the icy moons of Saturn, and on our moon. This was accomplished by measuring the relative diameters of impact craters, and the lengths of shadows cast by these surface features in relationship to the diameter of the moon's image on a photograph of that moon. By measuring this proportion, and obtaining the accepted diameter of the moon from the scientific literature, it is possible to calculate the actual diameter of a crater or length of a shadow on that moon. By utilizing the principles of spherical geometry, it is possible to account for such variables as foreshortening of the dimensions of craters near the moon's limb, and the solar elevation at any given location on the disk on the moon. Mathematical data reduction was aided by a program I wrote the IBM PC in the language Turbo Pascal. The results of this study were displayed in the form of a graph of impact crater depth vs. crater diameter for a large number of craters on each of the moons. The results of this study indicate that larger and more massive moons will exhibit impact craters with a deeper depth to diameter ratio than smaller and less massive moons with a similar surface composition and temperature. It is my hypothesis that this effect is due to the relative higher impact velocity of a meteorite under the influence of a stronger gravitational field. The importance of surface composition on crater depth to diameter ratio is revealed by the fact that impact craters on the surface of the moon are significantly shallower than craters of similar diameter on the icy moons of Saturn that were studied. The the results presented here represent original research.

***Honorable Mention - Eastman Kodak Company**
Honorable Mention - National Aeronautics and Space Administration

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*A STUDY OF THE TOXIC EFFECTS OF MARINE SEDIMENTS ON SELECTED BENTHIC FAUNA

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Many bays and estuaries which support large amounts and diversity of marine organisms are being harmed or destroyed by the discharge of inadequately treated domestic and industrial wastewater. These wastes include bacteria and heavy metals which may settle onto the marine sediments and increase in concentration over time.

Benthic organisms with frequent contact with such altered sediments may absorb deposited heavy metals into their tissue and consequently transfer such contaminants to organisms feeding on berthic life forms.

Previous studies by this researcher have indicated a problem with contaminants in marine sediments of St. Andrew Bay. This year's research focuses on the effects of exposure to these sediments on organisms of two different marine phyla.

Contamination of marine bottom feeders by contact with such sediments poses the threat of entry into the marine food chain which may ultimately affect higher level organisms such as humans.

***Fourth Award - ISEF/Earth and Space Sciences**

HEAT EXTRACTION FROM THE MICROBIAL DECOMPOSITION OF ORGANIC MATTER

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The energy produced by the microbial decomposition of organic matter has largely been ignored for use as an alternate energy source. Through my experimentation, I determined the feasibility of using this heat as an energy source.

I constructed an apparatus to measure the amount of heat generated by the decomposition of organic matter. The apparatus consisted of an insulated heat generation chamber, a heat extraction system, and a radiation system. Heat production from the decomposition of several types of common materials (grass, straw, hay and leaves) was measured and compared. Over 200 tests were conducted in which temperature and moisture were carefully monitored. The effects of moisture, temperature, and heat extraction upon the rate of microbial growth and heat generation were controlled, measured, and varied individually. The analysis of the gases showed primarily ammonia and carbon dioxide production. These gases were removed from the system.

From the experimental results, the optimal conditions for heat production were established: temperature in the range of 34-40 Celsius, moisture at 100% humidity, heat extraction not exceeding 2000 kJ/cubic meter, and continuous removal of gases. A functional microbial organic decomposition home heater was designed. Calculations were made and the model was scaled to meet home heating requirements. The experimental results and calculations support the hypothesis that a system of this nature is suitable and economically feasible as a supplemental home heating device.

#Alternate - U.S. Department of Energy Trip

THE EFFECTS OF WEST DESERT PUMPING ON THE MINERAL EXTRACTION INDUSTRIES OF THE GREAT SALT LAKE AND SURROUNDING WEST DESERT.

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The Great Salt Lake has been recently rapidly rising, causing millions of dollars in damages to mineral extraction industries through flooding and de-concentration of water. In April of 1987, the West Desert Pumping Project was instigated, alleviating flooding and slowly re-concentrating the brine. My predictions have been based on sampling, data collection, and analysis for chemistry and density. Samples were taken from Kaiser canals, piezometer wells, and the West Pond to trace movement of high sulfate waters. Water was shown to move from the West Pond to the canals in about two years. An evaporation test was then done on canal water to observe changes in the phase chemistry at different levels of contamination with West Pond brine. Conclusively, the industries directly surrounding The Great Salt Lake will benefit from lower water levels and more concentrated brine, but Kaiser Chemicals, in the West Desert may experience adverse effects, as their feed brine is being slowly contaminated by West Pond water which would significantly raise their sulfate ion ratio restricting their production of potassium chloride in the end stages of their evaporation process.

#First Award - Association for Women Geoscientists Foundation
First Award - National Water Well Association
Second Award - American Geological Institute
Third Award - ISEF/Earth and Space Sciences

# THE FOURTH PLANET: A STUDY OF THE POSSIBILITY OF LIFE ON MARS WITH THE PROPERTIES OF B.PSYCHROSACCHAROLYTICUS AND B. MACQUARIENSIS

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I have been fascinated with the concept of life beyond earth for most of my life. Many scientists believe that the most likely place for life as we know it on earth is on the planet Mars. Because of this fascination with possible extra-terrestrial life, I chose as my project the exploration of possible life on Mars. The purpose of my project was to discover if life with the properties of B. psychrosaccharolyticus or B. macquariensis could exist on Mars.
My hypothesis was that B. psychrosaccharolyticus and B. macquariensis could survive in the lower elevations and middle latitudes of Mars.
To carry out my experiments, I first had to prepare 15 plates for each bacteria for each test. I then placed 10 plates of each type of bacteria into, first, the separate elements of the Martian environment, then the Martian environment as a whole. Five plates of each type of bacteria were set aside in each test to act as controls. All 30 plates in each test were allowed 48 hours to incubate. Pictures were taken and colonies were counted using the standard plate count method after each test.
The bacteria survived every test, even though there was almost no visible growth in the two tests where temperature was a factor. However, there was an unexpected growth of spirogyra in the Martian environment test.
My hypothesis was proven to be correct. Life with the properties of B. psychrosaccharolyticus or B. macquariensis would be able to survive on Mars in the lower elevations and middle latitudes.

#Third Award - American Geological Institute

The Geochemistry of the Lexington Limestone Formation

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This research has a twofold purpose, first, to see if a method of titration is viable as a means of calculating the amounts of Calcium and Magnesium in samples of Limestone. Secondly, to analyze the Grier, Tanglewood and Millersburg Members of the Lexington Limestone Formation geochemically to try to infer its nature at the time of deposition.

EDTA titrations determined Calcium- Magnesium hardnesses for known test solutions. Then procedures with Calcon, Calcein and Hydroxy Naphthol Blue indicators were used to determine the Calcium Values. Magnesium values were then determined by subtraction.

Tests show the Calcon indicator best for Calcium with 0.5% error. Hydroxy Naphthol Blue and Calcein had 1.5% and 1.92% errors respectively. Problems occur with the subtraction for Magnesium as errors ranging from 6.6% to 25.12% developed.

The relative positions of sites on tongues of the members of the Lexington Limestone were examined by Atomic Absorption for Ca^{+2}, Mg^{+2}, Sr^{+2}, Fe_2O_3 and Manganese content. Ratio calculations and other comparisons were made to relative locations. Data showed a randon distribution suggesting that the chemical nature of the rock had been greatly altered during diagenesis and inferences cannot be made at this time

ENHANCED SOLAR STILL (DESALINATION II)

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Two years ago I proved that a simple solar still can distill seawater taken from Galveston West Beach through the use of natural sunlight. The results were confirmed by laboratory testing. The purpose of this experiment is to find a way to enhance this solar still in order to make it efficient, practical, and cost effective on a large scale.

For this experiment, two identical solar stills are constructed (one "control" and one experimental). The control solar still contains a plain black bottom aluminum pan. The experimental still contains one of the following: a) a black rock bottom pan, b) a black corrugated aluminum pan, c) black Rit dye added to the salt water, d) one tablespoon of Ivory Liquid detergent added to the salt water, e) three molar Hydrochloric acid added to the salt water, f) a damp black curtain, g) a slight suction attached to the solar still's hood, and h) a damp black curtain plus a slight suction. Each experimental system is run against the control solar still. Each still contains a black aluminum pan filled with 1500 ml. of salt water. The stills run for two days or until substantial data is gathered. The data collected is charted in time verses amount of distillate, and the average distillate rate of each still is compared.

Data shows that the black curtain, suction, detergent and HCl acid increase the potable water rate. A damp black curtain hung in the solar still's hood more than doubles the distillate output rate. Added suction increases the distillate output rate by 110%. The use of detergent provides a 27cc increase during the first eight hours of testing, and the use of 1cc of 3M HCl acid shows a 20cc distillate increase in the seventh hour of testing. When the damp black curtain and the vacuum pump run at their maximum potential the amount of distillate increases 300%.

#Fourth Award - ISEF/Earth and Space Sciences
Alternate - U.S. Department of Energy Trip

AN INVESTIGATION OF STARCH GRAINS AS POSSIBLE GRAVITY RECEPTORS

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The year is 1988, the Earth is in the midst of the Space Age. We have walked on the moon, sent space crafts hurtling from our galaxy, observed the deaths of stars, and placed destructive weapons in orbit around our planet. However, the mere concept of gravity is far from being fully understood. The problems created in a gravity-free environment have, until recently, been considered undeserving of practical consideration. Now researchers must begin to seriously consider gravity's control over organisms. Once this pehnomenon is fully understood, scientists may begin to develop organisms that can survive in gravitational surroundings much different than that of Earth.

Our first step towards this ultimate goal is the discovery of gravity receptors in plant cells. By exposing plants to a simulated gravity-free environment, we may study their growth patterns. The data recorded from these observations can then be used to indirectly determine the cellular structure responsible for gravity perception in plants. This important breakthrough will carry us many steps further into the Space Age.

#Second Award - U.S. Air Force

DETECTING CHANGES IN ORBITAL PERIODS OF ECLIPSING BINARY STARS

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Eclipsing binary stars are solar systems in which two stars orbit around a common center of mass. The orbital planes of these systems are tilted at an angle close to our line of sight on earth. As the two members of these systems orbit around one another, they eclipse each other. The greatest light loss, termed primary eclipse, occurs when the hotter star is eclipsed by the other member of the system. The point in time at which primary eclipse occurs is called the time of minimum light.

The time of minimum light can be calculated based on photometric observation of the primary eclipse and then be used to compute the orbital period of an eclipsing binary system.

Small shifts in a system's center of mass can result when mass is transferred between stars or mass is ejected from the system. A change in an orbital system's period will reflect a shift in the system's center of mass.

Eclipsing binary system WY Cancer was the subject of this research project. All obsertions were made with the 41-cm Cassegrain reflector at the Gayle Riggsbee Observatory and all data reductions and computations were executed using computer programs specifically designed for this project.

The analysis of data obtained by differential photometry techniques indicates that the orbital period of WY Cancer has shortened by approximately .3995 seconds. This is the first significant change in this star system since the early 1970's. These new findings will be published in the Information Buletin on Variable Stars.

*First Award - U.S. Army
Second Award - ISEF/Earth and Space Sciences
Honorable Mention - National Aeronautics and Space Administration

SIZE ANALYSIS OF VERY COARSE GRAINED SEDIMENTS

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PURPOSE: This Science Fair project is to determine if very coarse grained sediments can be measured as accurately using photographs as measuring them in the field.

PROCEEDURE: Several exposures of very coarse grained sediments were photographed on the Fiddlers Canyon alluvian fan and in Coal Creek Canyon, Iron County, Utah. Photographs of the 2 most appropriate outcrops were enlarged to 12.5 mm X 17.5 mm. More than 100 rocks were measured on each photograph, essentially all of the rocks that could be measured. Measurements on the photographs were made using a pair of dividers and comparing the opening with a meter stick in the photographs. A meter stick was included for scale in all of the photographs.

Next, the same rocks were measured in the field to see how accurately the measurements from the photographs compared. A large pair of homemade dividers and a meter stick were used. These 2 sets of numbers were compared statistically using an EXCEL program in a MACINTOSH II computer.

CONCLUSIONS: Based upon Regression Curve values greater than 0.96 and Least Squares slope near 1.00 for the paired points, it appears that this is a viable process.

THE ORION NEBULA AND ASSOCIATED "IN" VARIABLE STARS

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Purpose - To determine if there is a relationship in the variation of brightness of "IN" type variable stars within or associated with the Orion Nebula.

Hypothesis - "IN" type nebular variable stars in the Orion Nebula will vary in brightness with a similar periodicity since they should all be at approximately the same stage of stellar evolution.

Procedure - A. Research - I read all available material on the Orion Nebular complex and variable stars in general; B. Experiment - Over a period of two months, I observed and recorded the magnitude of six "IN" type variable stars in the Orion Nebula.

Results - A. Research - The Orion Nebular complex is a huge area of gas and dust. Stars have recently formed and are now forming in this cloud. The brightest cluster of these has blown away the obscuring dust and is now called the Trapezium. There are four main classes of variable stars; pulsating variables, explosive variables, rotating stars, and eclipsing binaries. Each class has a unique method of variation. The Hertzsprung-Russel diagram is a useful tool that allows astronomers to more fully understand stars, their evolution, and their peculiarities; B. Experiment - The six stars I observed in the vicinity of the Orion Nebula experienced both regular and irregular variations. The data gathered indicated similarities in the regular variations of the stars I observed.

Conclusion - There is a similarity in the variation of brightness of "IN" type variables in the region of the Orion Nebula.

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*CONTINUED ANALYSIS TOWARD A DIFFRACTION LIMITED IMAGE OF R AQUARII

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R Aquarii is a variable, binary star in the constellation Aquarius. It is of great interest to the astronomy world because it changes very rapidly, has circumstellar nebulosity, appears different at different wavelengths, and has a curious bipolar jet feature. Prior to this research, a resolved morphology of the binary system has been unattainable because of the star's magnitude and distance from the Earth.

In prvious analysis with Speckle Interferometry, the autocorrelation function was used to create symmetrical image information about the star. This year's research is divided into two parts. The first part involves a complete reconstruction of the H alpha data obtained in 1983. This is done by using the Knox- Thompson cross correlation function so that the phase information about the star can be reduced. Combined with the amplitude information from the autocorrelation function, a complex image is created. The second part is required for a multi-wavelength morphology needed to prove that the resolution is the binary itself. Observations were completed at Kitt Peak National Observatory in August 1987. These observations were done at the oxygen wavelength and in a continuum. Reduction of this data should invalidate any question about the H alpha resolution being something other than the binary.

Amplitude information displays a definite resolved component at the same angle that lobes were detected in the preliminary analysis. A spectrum taken while the star was being observed shows an emission line at the oxygen wavelength, supporting the theory that R Aquarii is now a resolved binary system.

This diffraction limited morphology of R Aquarii, previously unattainable, will contribute greatly to the research of this system and to the study of a universal physical phenomenon the bipolar jet feature.

*First Award - National Aeronautics and Space Administration
First Award - U.S. Air Force
Second Award - American Astronautical Society
Fourth Award - ISEF/Earth and Space Sciences

*STATISTICAL ANALYSIS OF THE EFFECT OF SOIL, AS A RESTRICTIVE FACTOR IN THE MAGNITUDE OF THE CONICAL PARAMETERS OF PITS BUILT BY THE ANT-LION MYRMELEON INSERTUS (HAGEN, (1923)

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Myrmeleon insertus-Hagen is a member of the family Myrmeleonidae, which is commonly known as ant-lion. This name comes from the fact that the larvae feeds itself from ants.

Several studies have been performed in the development and ecology of this insect but no direct emphasis has been given to the soil. This investigation represents an attempt to increase our knowledge on the behavior of the species found in Puerto Rico, Myrmeleon insertus Hagen; in particular to determine the composition of the soil, chemical content and the effect that soil has in the construction of the cone. Special attention will be given to physical aspects involved in the throwing of soil particles.

Of the chemical components of the soil, it has been demonstrated that it has a high contents of nitrogen, phosphorus and potassium. It has been also demonstrated that the soil is moderately alkaline.

The ant-lion builds traps in a cone form. After making 247 combinations and analizing its structure, it was found that the particles size has an effect on the construction of the cone. The results revealed that the diameter of the cone tends to increase with 0.425 mm, 0.25 mm and 0.18mm particles and it tends to diminish with 0.30 mm and 0.125mm particles.

*First Award - U.S. Navy
Honorable Mention - Eastman Kodak Company
Alternate to London International Youth Science Fortnight Trip - U.S. Navy

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* FIELD H_2O CAPACITY AFFECTED BY ORGANIC MATTER CONTENT, TOTAL PORE SPACING AND EXCHANGEABLE H^+ IN THREE AGRICULTURAL SOILS

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The reason for this project is to find the effects of exchangeable H^+ pore spacing and organic matter content on the field water capacity of three agricultural soils.

Test for organic matter: Weigh a porcelein crucible, record the weight weigh 5.0 grams of soil in crucible, record weight and place in furnace. Heat 30 minutes at 350 degrees celsius, cool to 100 degrees celsius then place in dessicator. After cooling, weigh crucible and soil again, record weight and calculate organic matter content.

Test for exchangeable H^+: Place 15.0 grams of soil in beaker, add 30 ml. 2 N KCl, stir and record the pH of the solution. Use calculations from chart to determine exchangeable H^+ level.

Test for pore spacing: Fill cylinder to 55 ml. mark with soil, pack it then record volume. Weigh sample out of cylinder, fill cylinder to 70 ml mark with water, pour soil into cylinder with water then record final volume at top of liquid. Complete calculations.

Test for water capacity: Weigh a 100 ml cylinder, record weight, fill to 100 ml with soil, pack it, weigh cylinder and soil, record weight then figure bulk density. Add 10 ml water to soil, let stand for few minutes and record amount of wetted soil then complete calculations.

I concluded that the TwC water capacity was greatest, the Bh had the second highest water capacity and the CfB2 had the third highest water capacity. Total pore spacing and organic matter content were the two greatest contributors to the water capacity.

*First Award - American Society of Agronomy

CAN SETTLING VELOCITY OF COHESIVE SEDIMENTS BE PREDICTED?

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The purpose of this project was to develop a computer model that could predict the settling characteristics of cohesive sediments at various concentrations. This data could then be used in the future to predict erosion and deposition of estuarine environments.

Cohesive sediment is composed of particles smaller than two microns (clay size and smaller). As the concentration of cohesive sediment in water increases, the settling velocity also increases. This occurs because the particles flocculate(bind together) and therefore settle faster. At a certain point, however, the particles have become so large that they are in a hindered settling range and begin to slow down as they act on each other.

First, an unknown concentration of Tampa Bay mud and water were poured into a 1.8 meter-high settling tube. Samples were taken at elevations of 5, 15, 30, 55, 80, 105, 130, and 155 cm at times of 0, 5, 15, 30, 60, and 120 minutes. 10 ml of each sample was then filtered and the weight of the sediment was determined. By dividing this weight by the amount of sample used, the concentration was determined.

The collected data was then entered into a computer program which calculated the average concentration and settling velocity for each specific time. A separate program was then written to predict the vertical profiles of sediment suspensions for different times. The program predicts highly accurately in the moderate concentration range, but as the concentration becomes extremely high or low, the program predicts slightly less accurately.

* SUNSPOT ACTIVITY: EFFECTS ON WEATHER: A THREE YEAR STUDY

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Meteorologists have long suspected that sunspot activity influences the weather. This research project deals with the two generally accepted theories relating to the study of sunspot activity and fluctuations in weather. Theory Two, the most widely accepted theory, states: 1) in a maximum year radiation to the earth decreases, and a) temperature and rainfall decrease, b) snowfall increases; 2) in a minimum year radiation to the earth increases, and a) temperature and rainfall increase, b) snowfall decreases. Four cities, at approximately the same latitude were used for the research: Roanoke, Virginia; Columbia, Missouri; Pueblo, Colorado, and San Francisco, California. The monthly average and mean temperature, rainfall, and snowfall were studied. Three minimum and three maximum years were included in the study as well as the years preceding and following those years, (1953-1958, 1963-1965, 1967-1969, and 1975-1980).

It was concluded, by using the fluctuations between temperature, rainfall, and snowfall for the cities and years studied, that Theory Two prevailed in most cases when different forms of computation were used to calculate the data. The temperature and precipitation numbers were compared on a monthly and yearly bases, each city was compared to itself and to the other three cities. The statistical comparisons were made based on monthly figures above and below the mean, percentages above and below the mean, averages above and below the mean. The statistical study did not show a direct correlation to either sunspot theory, only a correlation between sunspot activity and weather.

***Second Award - American Meteorological Society**

WEATHER: PREDICTABLE OR NOT?

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Since the earliest times, man has been trying to understand and forecast the weather. Some methods have been accurate, but many have not. The methods which have been accurate involve many complicated factors that the average person cannot understand. I developed the Weather Prediction Chart (WPC) to forecast the weather of the following day. It applies six factors that are easy to observe without complicated or expensive equipment.

PROBLEM: The forecasts for chance of precipitation and wind direction were only about 50 percent accurate. Is there a method to improve the accuracy of the WPC?

HYPOTHESIS: A method could be developed to average the actual weather that occcurred under each catagory in the WPC.

PROCEDURE: 1. Develop the Weather Sheets, which list A) the conditions from which the weather would be forecasted, B) the original forecast listed on the WPC, and C) the actual weather that occurred after using the WPC. 2. Develop several methods to average the six factors, including using ratios, averaging, and dividing the averages by two. 3. Make predictions, starting in January 1987, using all averaging methods to find out which method would lead to the most accurate forecast. 4. Observe sky color each day at ten minutes after sunset and compare it to the following day's precipitation.

RESULTS: 1. The wind direction accuracy improved 20 percent by using the ratio method. 2. The cloud coverage accuracy was 50.21% by using the ratio averaging method. 3. The accuracy of the forecasts for temperatures did not change through any averaging method, when compared to the accuracy of the WPC predictions. 4. The accuracy for the precipitation predictions was 91% accurate using the average divided by two method. 5. The sky color can be used to predict the chance of precipitation. Currently, the accuracy of my predictions is exactly the same as the accuracy of the predictions of one of the meteorologists I surveyed.

#First Award - American Meteorological Society

#A COMPARATIVE PHYSICAL AND STATISTICAL STUDY OF PARTICLE SIZE CORRELATIONS ASSOCIATED TO CHANGES IN PROFILES OF BEACHES FROM S. W. PUERTO RICO: EMPHASIS ON THE EFFECTS DUE TO OCEANOGRAPHIC FACTORS

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This study represents an attempt to study the physical and chemical traits of the sands from 32 beaches around the Island. It was found that the peculiar characteristics that identify each beach changes from time to time. These variations can be observed in properties like sand color and particle size. The sand color ranged from white to black, this as a direct product of the different sediments which presented different mineralogic composition.

The particle size variation can be caused by different oceanographic factors like beach rock, which also define the beach profile. It also determines the strength and continuity the beach shore is stroke. It constitutes a limitint factor for the sediment deposition.

After a year of study focussed on particle size it was attempted to establish a correlation between particle size and changes in the profile of the beach. Six stations were sellected for this study in the western area of the Island. They were visited monthly during a period of five months. Here the profile measurements and representative samples of the different zones composing the beach were obtained. Then the particles were separated in different sizes by the sieve method. A reorganization using statistical parameters was done to correlate them with the profile.

#Honorable Mention - Eastman Kodak Company

# TROPISM IN A SPACE ENVIRONMENT

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In a space environment a substitute for gravity's effect on root growth direction is needed. Likewise, food needs to be grown rapidly. Tests were conducted using corn and oats seedlings to determine root response to direct current and static electric fields. Different light cycles and light durations were presented to optimize the stems' growth rate.

Seedlings were rotated at 2 rpm between a static electric field of 0.001, 0.01 and 0.2 volts/millimeter. Seedlings were grown with 0.1 and 0.3 milliamperes of current passing through the water. To determine the optimum light cycle, seedlings were grown with 0, 1, 2, 4, and 12 light-dark cycles per day. One group was grown with 4 cycles but with 5 hours of light and one hour of dark per cycle.

Roots and stems both showed a positive response to a static electric field of 0.01 volts/millimeter but at higher voltages the roots quit growing and the stem growth rate was reduced. Seedlings grown with current flowing through the water grew normal stems but no roots. Seedlings grown with twelve light cycles per day grew the fastest. Seedlings that grew in constant light grew the least; however, the seedlings with 4 cycles and 20 hours of light grew more than seedlings receiving one or two cycles.

These experiments show that in a space environment an electric field can be used to determine the direction roots grow and increasing the number of light cycles will increase plant growth.

#Third Award - ISEF/Earth and Space Sciences

THE EFFECTS OF ACID RAIN ON BUILDING MATERIALS

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This project investigated the effects of acid rain on building materials. Solutions of nitric acid and sulfuric acid and a combination of the two were prepared at different pH levels. In the first stage (1986-87) marble, brick, concrete, and granite were tested and exposed to various acids at different pH levels. In the second stage (1987-88) of the experiment, the previous materials were tested, gabbro and mortar were added, thin sections were made, and photomicrographs were taken. The photomicrographs were used to determine the basic composition of the building materials, These experiments, that simulated rain fall, were repeated eight times. The mass and dimensions of the materials were recorded before and after the experiments. The control used in these experiments was pH 6.

In observing and comparing the data collected, marble, concrete, and mortar were affected the most, however in one pH the brick had a greater mass loss. The combination of sulfuric and nitric acids caused a greater percentage of decrease in mass than the two acids separately. It was found that pH 3 caused the greatest percentage of decrease in mass.

The results of this research and experimentation should be considered as a starting point for years of experimentation and testing of other hypotheses.

#Honorable Mention - Association for Women Geoscientists Foundation

* GEOTHERMAL STUDY OF THE RIVER SKANE

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Glen Lodge, Tara, Co. Meath, Ireland.

A previous project showed the River Skane maintained a higher temperature 1°C than two other neighbouring similar small rivers, all of which are tributaries to the larger river Boyne. The object set was to find out why. The Skane was divided into seven sections. In each a station was established. Temperatures were monitored at each station over a period of time. From the collected data, temperature gradients were drawn and the temperature abnormality was identified in one section. Temperature gradients in two minor side streams showed two further hot spots. Four causes for this heat were considered: Biological, Chemical, Solar and Geological. Biological tests, BOD and an ecological study showed no adverse activity. Chemical assays also showed no anomalies. Similarly the period over which the project was carried out and previous observance gave no reason why solar or atmospheric conditions should be the cause. The conclusion was that the heat was geological in nature. The adjacent field was examined. Infra-red photography showed a warm area in the field and ground temperatures confirmed this. It was further concluded that the action was in fact Hydrogeothermal.

*First Award - ISEF/Earth and Space Sciences
First Award - Society for Exploration Geophysicists
Honorable Mention - National Water Well Association
Alternate - U.S. Department of Energy Trip

* DIGITAL SEISMIC DATA COLLECTION

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The purpose of this project is to develop a digital seismic data collection system that is efficient, versatile and economical. The mechanical part of this system is a Lehman Seismograph, constructed from plans published in "Scientific American" magazine in 1979.

The advantages of digitizing the data include: playback at convenience, it can be left unattended for long periods of time, it eliminates the need for an expensive stripchart recorder and it can manipulate data in many useful ways through dilation, amplification or compression.

This system has been designed for an Apple II computer. It is ideal for use in schools, laboratories or the home.

*Second Award - ISEF/Earth and Space Sciences
Alternate - Society for Exploration Geophysicists Trip

THE EFFECT OF SOLAR ACTIVITY ON THE WEATHER

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The purpose of my research was to determine how sunspots affect the weather in the temperate climate of the southeastern United States over daily and monthly periods.

The investigative procedure of my project was divided into four observation periods containing at least twenty-one observation days each. During each observation period, daily weather data was recorded and solar activity was observed on every day possible using a solar filter that I constructed myself. Solar photographs were also made near the peak of sunspot activity for each of the last three observation periods. The results led me to conclude the following:

> If the area of the solar surface covered by sunspots is greater than two significant sunspot units, then daily high temperatures are likely to remain at or above normal, and precipitation is not likely to occur. If the area of the solar surface covered by sunspots is less than three significant sunspot units, then daily high temperatures are likely to fluctuate among above-normal, normal, and below-normal temperature readings, and precipitation is likely to occur. Monthly precipitation totals are likely to be lower on months with higher average sunspot quantities.

I hypothesized that the increases in daily high temperatures in correspondence with increases in sunspot quantities were probably because of the extra radiation produced by the large faculae, or hot, bright areas surrounding all sunspots.

ENGINEERING

THE EVOLUTION OF A ROBOTIC ARM

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The purpose of this project was to study design problems associated with robotics. Several different fields of engineering are incorporated into robotics. Topics in electrical, mechanical, and software engineering were studied. These studies were done through research, interviews, scale modeling, computer simulations, and trial and error testing procedures. The major studies that were conducted were: 1) How to weight the robot, 2) How to break the movement of the joints, 3) How to control and accurately position the arm from a computer.

After two years of planning, building, testing studying, and then building again, the robotic arm has been completed and now awaits programing that will take advantage of its flexibility. The original goal of an energy efficient, flexible, robotic arm has been accomplished. A wide range of experiences were encountered, from old stubborn stockmen, to Analog to Digital converters. From the original inspiration to the finished product, the robot has provided an interesting, educational road that presented many diverse problems.

***Fourth Award - ISEF/Engineering**

# The Inventing and Developing of the S.S.A.V.E. Windmill

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PURPOSE: An extremely high rate of windmills are being destroyed annually by unexpected high winds. This problem has stunted the growth in the windmill market. This is occuring because the windmills of today are actually promoting the problem they are trying to avert because they are equipped with devices that increase the forces acting on the windmill when they try to slow the windmill down.

HYPOTHESIS: A new self governed windmill can be invented that slows in high winds, but does not increase other forces acting on the windmill, and also making use of these high winds.

PROCEDURE: Using a knowledge of the mistakes often made in the construction of windmills, and after making several plans, theories, and adjustments, I developed a plan which I believed to be the best. I then constructed and tested the windmill.

CONCLUSION: I proved my hypothesis correct, and I have filed a patent disclosure to ensure the protection of such a revolutionary device. I also have filed several forms to American Idea Marketing and Management to market my project. It can also be projected that The S.S.A.V.E. Windmill will renew the interest in the windmill market. Within the next few years, it is expected that the S.S.A.V.E. Windmill will sweep the windmill market

#First Award - Patent and Trademark Office/U.S. Department of Commerce/Patent and Trademark Office Society
Honorable Mention - American Intellectual Property Law Association

IMAGE ENLARGEMENT THROUGH THE SPREADING OF COHERENT PHOTONS

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The purpose of this project is to create an inexpensive projection microscope. It uses a low power laser beam to light a specimen. The beam is separated by two lenses, and a variety of magnification powers can be achieved by moving one of the lenses. This lens is mounted on a motorized track that can either be controlled by two buttons on the device, or by a computer for more accurate magnification. It was found that with two +10 lenses, a maximum magnification of 1324 power can be achieved. Different lenses can be substituted to achieve different amounts of magnification. This project has gone through several stages, covering over a year and a half of design work. It was originally designed to use a higher power argon laser, but because of design problems a low power HeNe laser has been substituted. It was found that although the quality of the magnified specimen was not as good as that of the $2500 projection microscope used as the control, the laser microscope was easier to use because there is no need to focus the device, and it costs $2300 less than the control. These factors may make it the best choice for school laboratories that can't afford projection microscopes.

#First Award - U.S. Navy
Fourth Award - ISEF/Engineering

*UTILIZATION OF THE FLEM-WING CONCEPT IN A SUBSONIC JET AND ITS POSITIVE ATTRIBUTES IN CONTRAST TO COMPARABLE TYPE CONVENTIONAL FLIGHT VEHICLES

PHASE 1

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This project deals with a new development in wing plan forms for commercial and possibly military applications. The designs I am proposing may change the current design layout of those military and commercial flight vehicles. The Flem-Wing is a new type of airplane configuration which employs tandem wings arranged to attach at an end plate, which functions as the primary yaw control device leaving the area between the fuselage and aft wing free of any parasitic and/or interference drag productions. The scope of this study is to determine the various control parameters and to compare and contrast the multiple type of flight vehicles I have designed. My hypothesis is as follows: incorporating the Flem-Wing concept in a subsonic jet will have the same appreciable lift along with significant reductions in parasitic and lift-induced-drag in contrast to comparable type conventional flight vehicles. The multiple wing plan forms were first designed on the C.A.D. system. Then entered into a computer program I had generated to calculate the various control parameters on a theoretical basis in order to optimize the design layouts. The multiple wing plan forms were built and tested in the 40" x 40" wind tunnel at Georgia Tech. It has been substantiated that the Flem-Wing X-1,2,4 has significant reductions in lift-induced-drag in contrast to the conventional wing plus tail configurations tested. The delta configuration had more appreciable lift over the X-1 and 2. This was made evident due to the wake of turbulence set up by the fuselage over the aft wing at high angles of attack and also has been contributed to interference lift at the juncture. Since the X-4 had an aft wing that was higher than other Flem-Wing designs, the wake of turbulence set by the fuselage had nominal effects on the lift characteristics of the aft wing thus making this design superior to the others tested.

***First Award** - **American Intellectual Property Law Association**
First Award - **American Astronautical Society**
First Award - **National Aeronautics and Space Administration**
First Award - **U.S. Air Force**
Second Award - **Federal Aviation Administration**
Second Award - **International Aerospace Hall of Fame**
Second Award - **ISEF/Engineering**

AN AUTOMATION OF THE HUMAN HAND: PHASE IV

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"An Automation of the Human Hand: Phase IV" is presently in its fourth year of experimentation. Each year the purpose has been to delve more indepth into the practical applications of robotics. The purpose was to develop a robotical hand, located on a plane, which simulates the movements of the human hand which a disabled person cannot perform. Two control systems were designed, one which utilizes a tilt switch application, located upon a headband, and the other, a manual switching box. The project is a concoction of various metals and plastics. The hand facsimile consists of five aluminum digits embedded into a two-layer plastic palm. All fingers are hinged in three places containing two degrees of freedom and a pressure sensor feedback system used in object retrieval. Eleven low-voltage high-torque motors were employed to efficiently and accurately carry out this task. The plane on which the hand is attached consists of a full rotary, vertical and horizontal rotary movement built from semi low-voltage high-torque motors and various components. This project has proven itself to be a success in experiments due to the fact it has achieved its purpose.

***Third Award** - **ISEF/Engineering**

A MANUFACTURING CELL: PHASE II

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In the first nine months of 1987, manufacturing production in the United States amounted to 1.8 trillion dollars. Some manufacturing is now being done by state-of-the-art automated flexible manufacturing cells. Three fundamental elements of an automated flexible manufacturing cell are production, material handling, and quality control.

My three year goal is to design, fabricate, and test an automated flexible manufacturing cell including statistical process control (SPC). In 1987, I built a computer controlled measuring machine which constitutes my inspection section (quality control). This year, 1988, I have added a robotic arm, the material handling part of my cell. Next year, I will build a production section which will complete my automated flexible manufacturing cell.

This year's goal was to build a computer controlled industrial style robot that would load parts on and unload parts off the measuring machine. The components of this project include computer software, an electronics package, a four axis robot mechanism, and a serial communication link between the robot's computer and the measuring machine's computer. The computer software consists of menu driven operator interface software, robot control software, and motion control software. The software is written in both assembly language and BASIC. Signals from a Commodore 64 computer are processed by an electronics package and drive motors on the robot mechanism. The communication link synchronizes the operation of the measuring machine with that of the robot.

#First Award - ISEF/Engineering
First Award - National Aeronautics and Space Administration
First Award - Society for Women Engineers
First Award - Rockwell International $3,000 Scholarship
Second Award - Society of Manufacturing Engineers
Alternate to Glenn T. Seaborg Nobel Prize Visit Award

L.O.C.H. UNIT (LATERALLY OPERATIVE COSMETIC HAND)

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The purpose of this project was to design a prosthetic hand with maximum efficiency and cosmetic adequacy. There are two types of hand replacements available today, the split hook and the mechanical hand. The hook is functional, and is comparable to using a pair of tweezers. The artifical hand provides the most cosmetic value, but the manipulation of this device is difficult. Consequently, most arm amputees use the hook for manual manuevers requiring dexterity while the hand is used only when extensive contact with the public is necessary.

A Laterally Operative Cosmetic Hand (L.O.C.H.) unit which combines these two units was designed, built, and field tested. Rather than having the vertical clamping motion of the present devices, the L.O.C.H. unit clamped horizontally, as if the fingers were hooks. This was accomplished by inserting a Hosmer 555 aluminum hook into the shell of a mechanical hand. A portion of the shell wall was removed to allow room for the lever of the hook. Fingers made of epoxy were fashioned to cover the hooks, promoting the cosmetic value of the unit. The thumb of the hand was equipped with a ratchet release which allowed it to be locked into multiple positions. This ratchet provided the L.O.C.H. unit with an additional gripping system. By releasing the catch on the side of the unit, the thumb dropped back to an open position so that the hook could be used with no interference.

The final result was a cosmetically appealing mechanical hand capable of performing the functions of both the hand and the hook.

#Second Award - ISEF/Engineering

AN ECONOMICAL WAY TO EFFECTIVELY REDUCE HEAT LOAD ON ROOFS

Gay, Hiram, Southwestern Educational Society, Mayaguez, P.R. 00709
Calle Obispo #221, Mayaguez, P.R. 00708

On this project aluminum cans were tested to effectively reduce the heat load on a house's roof. Two concrete slabs and their supports were placed on top of a roof. A styrofoam house enclosed each slab and its support. A hole was drilled at the bottom of each of the 65 cans used. They were placed on top of one of the slabs with their bottoms up. The other slab was left plain; it would serve as a control. Thermo couples were placed on the slabs to measure their temperatures. Other thermocouples were used to measure the air temperature, the air temperature inside each of the styrofoam houses, etc. Data was recorded for three days. Finally, the aluminum cans proved to reduce the heat load on roofs (up to 8°F); still this method could further be improved. For one thing, this method is more economical than others.

HYDROGEN: A STUDY OF ELECTROLYSIS TECHNIQUES TO DETERMINE ENERGY EFFICIENCY

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In this project, electrolysis techniques were studied to determine the most efficient way to produce hydrogen gas using solar energy and ocean thermal gradients. Electrolysis of water produced hydrogen gas and oxygen gas. Two platinum rods served as electrodes connected to a D.C. power source. The electrolyte was varied between different concentrations of sulfuric acid, acetic acid, and salt water. Various voltage potentials were tested to find the most productive potential. Operating efficiency was determined based on the number of moles produced, efficiency of production, and cost per mole. The most efficient concentration of acid was discovered to be 20 ml of sulfuric acid in 130 ml of H_2O at a voltage of 10 volts. This concentration and voltage produced hydrogen gas with a 98% efficiency. 0.00014 mole was produced at a cost of 4¢ per mole. Because of the cost of electricity, solar energy and energy from ocean thermal gradients provide alternatives to some of the energy problems of today.

ESTIMATING THE EFFICIENCY OF FUEL CELLS CONTAINING BACTERIA

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What is hoped to be accomplished is to construct an energy efficient organic fuel cell. In a prior year's experiment, it was determined that in the cell set-up displayed, iron and carbon combined with water was capable of producing 100 microamps of direct current electricity. Of the four metals tested; iron, zinc, copper, and lead, iron was the most effective at producing electricity. To improve on the efficiency of last year's cell was the objective of this year's project. Research was done in the feild of organic fuel cells. Four non-pathogenic bacteria were used: Oscilletora, Gleoscapa, Spirogyra, and Odeogonium. All four increased the the electrical output but not the efficiency of the cell. Oscilletora had the highest production rate with three amps. The problem with these cells was that they would breakdown within an average of three days, returning to the 100 microamps produced by the original set-up. With more research and experimentation, it is hoped that a larger yet moderately sized fuel cell can be constructed. The goal for this cell is the capability of producing enough current to supply all the electrical needs in a single room in a home.

# DESIGN AND ANALYSIS OF ROBOTIC...THE BEST DEFENSE

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In security systems today, there are many flaws and inaccuracies. The purpose of my project was to overcome some of these flaws. I constructed a mobile robot with a helium-neon laser scanning system. The robot is controlled via a Commodore 64. The computer was used to program the robot to take a specific course on the floor and also to process the data incoming from the laser receiver. As the robot rolls across the floor, the scanner plots all the coordinates of the objects in the room at a three degree interval. The robot can then continue onto another room and scan there as well. When the robot returns to the scanned room, the computer will check its memory as it is rescanning the room. If anything has changed within the last round, the computer will pick up the error and set off an alarm. This was tested by securing my basement for two hours. As the robot was scanning, I moved in and out of the room different objects to see if the computer would pick them up as an error and set off the alarm. The robot was noted to sense a change as little as three inches.

Some of the problems that had to be overcome were 1) error in the tracking of the robot 2) floor surfaces such as rugs and porous surfaces could not be used because of the steering system, (it would slide and lose course) 3) limiting factors in the computer memory (the computer used only has 64K of random access memory); therefore, the robot could only hold the scans of two rooms before running out of room in the computer. These were some of the setbacks and could be overcome with further research and development.

In conclusion the robot was found to be very useful and did have some advantages over the opposing non-mobile security systems, such as: the robot can pick up movement faster and more reliably than other systems, it is mobile therefore it can secure more places for less money using less sensors, and replace or be used as a security guard. Thus, it was named "SENTRY II".

#First Award - ISEF/Engineering
Second Award - Rockwell International $2,000 Scholarship

Innovative Drilling Technique

Aaron Kiss
Linsly School
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The process of earth drilling has always been a tedious and expensive undertaking. It is most diffricult to arrive at a perfect mechanical installation.

Today, each section of drilling casing is thirty feet in length. When the casings reach the drill site, they are connected into groups of three, and then stacked into the tall steel derricks. In order to maintain all of the equipment, some of these towers must be at least one hundred and fifty feet in height, and can take a week to build.

I am proposing an alternative concept. Rather than incorporating long segments of hollow casing used today, there would be shorter sections which would be hinged together for ninety degree flexing and linked by bearing races for three hundred and sixty degree rotation to allow the strand of short pipes to be rolled up onto a large wheel.

This concept is not just another small change or improvement. It is a completely new approach to earth drilling.

The use of the new retractable and foldable casing will hopefully change and improve the process of earth drilling by using less manpower, fuel, and time.

#Third Award - American Society of Civil Engineers
Third Award - National Water Well Association

#

THE NEXT GENERATION

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The intent of the experiment was to determine which of several new and radical wing configurations would prove to be the most efficient in the areas of stall speeds, horsepower requirements, lift, and drag. A cylindrical, low-speed wind tunnel was designed and built to carry out tests in these areas; results were derived from raw data readout recorded in volts. Testing trials consisted of 12 data points, recorded at angle of attack increments of 5 ranging from 0 - 55 . Angle of attack would be the angle of the wing in comparison to the horizontal wind flow The designs used were derivatives from three years of past experimentation, these included: the pathagonal wing, the forward sweeping wing, and the ring wing. No single wing performed in such a standard that it could be deemed the "best," rather individual results rendered a set of "winners."

Results revealed the forward sweep performed well in stall speed comparison, but lagged far behind in the other criteria. With the pathagonal design came good results in horsepower requirements, staying consistent through all angles of attack, along with higher stall speeds and a high stall angle. In respect to lift and drag characteristics, the ring gave better lift potentials at lower angles of attack, whereas the pathagonal had slightly better readings at high angles of attack angle. These results bring concepts of usage into the scientific analysis. In usage or purpose at low speeds and low angles of attack, the ring performs its best, while the pathagonal performs the most efficiently at high angles of attack and high speeds. The "best" wing may not be derived from any testing procedure prior to a determined purpose for that craft.

#First Award - International Aerospace Hall of Fame

CARBON VS METAL PISTONS: WHICH PRODUCES MORE HORSEPOWER?

Schwind, Michael P. Everman High School, Everman, TX 76140
5385 Brown Lane, Fort Worth, TX 76119

The objective of my project was to compare the horsepower output of a stock metal piston to that of a carbon piston. After obtaining the motorcycle (with the metal piston) and the carbon piston, I then found a suitable dynamometer. After talking to the owner of a the motorcycle shop where the dynamometer was located, the owner became very interested and allowed me to use his dynamometer equipment. The procedure, after many trial runs, went as follows: 1) secure the motorcycle on the dynamometer 2) rev the engine to the desired RPM level 3) increase the drag on the engine until a consistent reading was produced. The tests were run a minimum of three times and an average horsepower reading was obtained. Not only were the horsepower readings of the two pistons compared, but also the carburetion was modified on the carbon piston. I had theorized that due to the qualities of similar carbon products, the carbon piston would not seize under leaner carburetion as a metal piston would. I concluded that with the same carburetion the carbon piston does not offer an increase in peak horsepower. However, with the modified carburetion allowed only by the carbon piston, a significant increase in top end (10,000 RPM) horsepower is achieved over a metal piston.

AERODYNAMIC STRUCTURES: THE FINAL STAGE?

Forrest, Teddy
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464 Macedonia Rd., Hammond, LA 70403

The basis of my research was to discover if it is possible to construct improved wing designs (relatively speaking) and to create new, inexpensive and reliable methods of testing these wings. After much trial and error, I came up with three wing designs which interested me. These designs include the variable position wing tips structure, the high camber wing, and the variable rotation wing-tips wing. I decided to use these wings as my testing wings. All three wings were designed with lift and stability in mind and are best suited for use with a small, slower aircraft. After the wings were constructed, I began to look for ways to test them for lift, stability, and other characteristics. After searching through many books and references, I discovered that there were very few ways of testing wings without going to large expenses. I then decided to come up with my own testing procedures and equipment. I first developed the Water Displacement Method of determining lift, and then created several other easy ways to test my wing designs. By using the methods I invented, I had a better understanding of what I was trying to accomplish and of how to use the equipment. I tested the wings while also testing my test equipment. Both turned out to be above adequate, and my project is considered a success. All data has been kept from my tests in the hope that they will prove useful to others.

BIG SHOTS! ARE THEY ALL THE SAME ?

Africa, Michael C., Francis Howell North H.S., St. Charles, MO
2092 Willow Trail, St. Charles, MO 63303 63303

My purpose is to determine if lead or steel shot will be more accurate at a distance of 40 yards and inside of a 30" and 20" circle. The testing is also to determine which brand, Federal or Winchester, is more accurate and better suitable for upland game and duck hunting.

My hypothesis is: Lead shot is more accurate at a distance of 40 yards than steel shot, and the two brands of shells tested will not be significantly different.

I took six Winchester and Federal lead shot loads. I also took six Winchester and Federal steel shot loads. Using a 12-guage shotgun, I fired at a target 40 yards away. I changed targets for every shot. I recorded the necessary weather information at the time of testing. After shooting, I drew a 30" circle around the greatest concentration of pellets and a 20" circle inside the 30" circle. I averaged the number of pellets in both circles. I then analyzed my results from the knowledge I gained from the Olin Winchester Group and Federal brochures.

The results to my project are that there is little or no difference in lead and steel shot overall. Federal proved to be more accurate than Winchester in lead and steel.

My conclusions were that lead and steel shot have the same accuracy up to 40 yards. After that, steel loses much velocity and penetration, where lead doesn't. In comparison, the shot cup in Winchester's lead shells doesn't protect the shot like Federal's shot cup does.

If I were hunting upland game, I would most likely use steel over lead because of the penetration steel has at short yards. For duck or goose hunting, I would use lead because of the range it has over steel.

COMPUTER INTERFACED ROBOT CAPABLE OF USING INTELLIGENT TECHNIQUES

Corralez,David J., Hobart H.S., Hobart, IN 46342
3945 Missouri St., Hobart,IN 46342

The purpose of my project is to apply the concept of artificial intelligence with the use of a Computer Interfaced Robot Capable of Using Intelligent Techniques. C.I.R.C.U.I.T. consists of various types of vision systems combined to produce an overall vision system. This system enables the robot to preform independent manueverability. C.I.R.C.U.I.T. utilizes the Tandy 1000 EX and the Epson Geneva PX-8 to transfer the data from the C.I.R.C.U.I.T's vision sensors to the computers ports. Then the data is processed by the program to make logical decisions in order to manipulate the robot. The system guides the C.I.R.C.U.I.T. on a route to a predetermined destination via avoiding,rerouting, and giving verbal commands, or requests to the confronted object. During a route the robot calculates distances between the object and itself, then using a preprogrammed equation alters the robots path. Once the confronted objects are avoided the robot reroutes back to the predetermined destination. This vision system could operate through infared sensors,motion detectors, or linear matrix processing.

While applying artificial intelligence to the C.I.R.C.U.I.T., I have produced a real robot by showing all of the following necessary requirements: first,mechanics,which consists of a mobile base,and mechanical appendages. Next, independence, which qualifies via its ability to move without manual control by altering its path to the predetermined destination. And finally, reprogrammability, which is accomplished by the programmer, or set to allow the robot to reprogram itself during a program using its artificial intelligence vision system.

*Fourth Award - ISEF/Engineering

DESIGN AND CONSTRUCTION OF A MULTIPLE AXIS PROSTHETIC FOOT

Krajmalnik, Enrique G.
Tom C. Clark H.S., San Antonio, Tx. 78249
3475 River Path, San Antonio, Tx. 78230

Uniaxial prosthetic devices greatly limit the movement accorded to an amputee; thus, the design and construction of a multiple-axis prosthetic foot, specifically for the above-the-knee amputee (AKA), was greatly encouraged. In a design of this nature plantar flexion, dorsiflexion, inversion, eversion, and flexing at the toes must be carried out easily and flawlessly, while maintaining a firm base for the relatively unstable AKA. Initially, an analysis of motion in the sagittal plane was required in order to obtain the necessary information about the lower limb and primarily the ankle joint as they progress through normal human locomotion. Furthermore, research into current prosthetics provided a basic knowledge of materials and design features which consequently led to a foot that incorporated a multi-axis anchor that was complemented by rubber bumpers. Based on the theory that the selective compression of the materials in the foot would result in the necessary motion, this foot also used a plate made out of a carbon composite that functions actively in toe-flexion. After testing the foot, it registered 31 degrees of plantar-dorsi flexion and 18 degrees of lateral motion. This was followed by another design that was named MAD, an acronym for Multiple Axis Design. In this design an array of four exponential, helical springs and four kevlar bands in a diamond pattern are used. This assembly is placed between two 2024 aluminum plates. Toe-flexion in the MAD is also attained by means of the carbon composite plate. Finally, the entire mechanism is placed inside of a soft foam foot.

* RA-3: THE DEVELOPMENT OF A ROBOT ARM

Perry, Nathan C., Marianapolis Preparatory School, Thompson, CT 06260
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The purpose of this project is the development of a robot arm which minics the dexterity of the human arm. RA-3 (robot arm, third model) is a third generation robot using concepts drawn from my earlier work. Rotational joints are used for torso, shoulder, flexion wrist (pitch), and supination-pronation (yaw) wrist. A linear actuator replaces the elbow for forearm extension. As the result of a study of mechanical drives, worm-gear and sprocket transmission were selected for the rotary joints with forearm motion provided by a linear rack and pinion. Stepper motors are used as the electromechanical drives. The steppers are driven by local controller chips which communicate over a common bus with the computer. This bus is interfaced to the computer using opto-isolation techniques.

The computer drives the joints open-loop using an unique initialization technique for "homing" the arm at power-up. Motion control may be input either with a joystick or by using voice recognition. Software to provide teach and playback modes for joystick input was also developed. Programming languages used during development include BASIC, compiled BASIC, compiled PASCAL, and machine language. Although simultaneous control of the joints was investigated, the speed of execution was unacceptably slow because of the limited power of the Commodore 64 computer. Sequential control proved to be the most effective for routine operation of RA-3.

*Third Award - ISEF/Engineering

STRUCTURAL TESTING OF BEAM BRIDGES

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The purpose of this research was to determine an ideal beam bridge truss structure which will provide the greatest strength to weight ratio. And, to discover what factors determine a bridge's strength.

To accomplish this main objective, the first problem that arose, was what to build the bridge trusses out of. (Note: The structure of the truss is to be tested, not the material itself.) The material which prevailed was plastic soda straws. The next problem which arose was how they were to be connected. After much thought, I chose to use a hot iron to melt the straws together ensuring that no foreign material was used.

When testing the bridge, I suspended the truss off the ground and weights were hung from them. Each truss tested was required to support the weight for 5 secouds, before weight was added. When the bridge collapsed, the amount of weight that it was holding was used as its "strength." From there, each bridge truss was weighed and a strength to weidht ratio was calculated to see which bridge truss provided the best strength when compared to it's weight. As a result of this data, new bridges will be constructed wher the "truss triangle" areas are the same, and the same procedure will be used like above.

At this point in time, I cannot give any set conclusions about how the strength vaires. To get an accurate view, more experimentation is needed.

* HUMAN-ROBOTIC INTERACTION

SCOTT WRIGHT
TUSCARAWAS VALLEY HIGH SCHOOL
A-69 LAKEWOOD DRIVE, MINERAL CITY, OH 44656

There is a need in our technological society for real-time human-robotic interaction to provide a greater degree of dexterity, accuracy, and flexibility in operation of robots to satisfy increasingly complex and demanding robotic tasks.

This year's research involved the design and construction of: 1) a force proportional tactile sensing system that senses the force applied by the robotic fingers and simulates it as a sense of touch on the operator's respective fingers; 2) a fiber optic control glove system that senses operator finger movements used to control the robotic hand, and; 3) an improved multi-degree-of-freedom robotic hand to serve as a test robot to evaluate the control and sensing systems.

The completion of this years research has resulted in an interactive robotics system that provides an extraordinary sensitive link between operator and robot with several types of feedback essential to the human-robotic interaction.

Applications include hazardous tasks that require human dexterity and intellect. Some examples are; work with pathogenic or toxic substances, tasks that involve high radiation levels, and work in space and deep sea.

*Operation Cherry Blossom Trip - U.S. Army
First Award - American Committee for the Weizmann Institute of Science
First Award - Institute of Electrical and Electronics Engineers
First Award - ISEF/Engineering
First Award - Society of Manufacturing Engineers
First Award - U.S. Army
Second Alternate to Scholarship - The Ohio State University
Honorable Mention - National Aeronautics and Space Administration

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A STUDY ON THE EFFICIENCY OF STORING SOLAR ENERGY AS COMPRESSED AIR

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6216 Appian Way Riverside, California 92506

In investigating the field of solar energy it was brought to my attention that although there has been a sufficient amount of research and development in the field of solar energy production, there has been a limited amount of development in constructing a feasible solar storage system.

Utilizing an external combustion engine fitted with a parabolic reflector, it was possible to convert solar energy directly into mechanical energy, which was then stored as compressed air. Efficiency studies were run to determine the practicality of this storage system.

From the results obtained from this small working model, it was concluded that although this is not a highly efficient system, it did reach an efficiency level high enough so that, in remote areas, this system would be a feasible alternate energy source that would be cost-effective. In areas where electrical power is readily available, this storage system does not prove to be a viable alternate energy source at this time; however, from the data collected, this system does warrant further investigation.

PNEUMATIC MUSCLES - A BETTER WAY TO BUILD ROBOTS?

Mark Larson
Westlake Village Junior High School
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The purpose of this project is to develop a lightweight and inexpensive means of motion for robotic arms. I approached the problem by studying how muscles power the human body. I then invented a pneumatic muscle built from wood, fabric, and a bicycle inner tube. It worked well enough to prove the concept. I then built and tested several designs of pneumatic muscles. I found that these are simple, powerful, inexpensive, and lightweight. I have developed a robotic backbone, robotic arm, and a robotic hand using pneumatic muscles.

THE RELATIONSHIP OF WING SWEEPBACK ANGLE TO AIRPLANE FLIGHT CHARACTERISTICS

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The purpose of this experiment was to study the dependence of flight characteristics of a plane on the wing sweepback angle. A balsa wood glider was built and launched from a home-built device, which provided control of the take-off angle and the launching thrust. Discrete values of the variables used include two launching thrusts, three angles of take-off, and seventeen wing sweepback angles. The average distance and flight time were determined for each set of experimental parameters. The optimum wing sweepback angle was found to be 10°, independent of the launching thrust and angle.

An original computer program was written to model the flight path trajectory as a function of drag-to-lift ratio, initial velocity, and launch angle. For each set of these parameters, the flight path angle was calculated for a sequence of times, to provide the horizontal and vertical distances flown by the plane. Comparison of actual flight results with the computer simulations demonstrated that the computer program is a realistic representation of actual flight.

PASSIVE DEVICES IN AERODYNAMIC DESIGN TO REDUCE DRAG INDUCED BY WING-TIP VORTICES

Brent M. Heist
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900 E. Redwood, Springfield,MO 65807

The reduction of wing-tip vortices due to the interaction between the high pressure of the lower surface and the lower pressure of the upper surface of the wing is gaining new popularity in aerodynamic design. It is first necessary, though, to determine the critical areas to vortex formation at the wing-tip.

This experiment investigated the effectiveness of vertical wing-fins as a barrier to the vortex formation in a wind tunnel environment. By testing various configurations of both upper and lower vertical wing-fins, new insight to the critical areas of wing-tip design were determined.

Analysis of the data will aid future development of passive devices to attenuate the formation of wing-tip vortices.

*Fourth Award - ISEF/Engineering

* USING THE "SWIRL EFFECT" TO ENHANCE THE ENERGY PRODUCTION OF A WATER TURBINE

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2162 W. 5650 S., Roy, UT 84067

After water passes through the blade of a water turbine, the water continues "swirling" in the same direction the blade is rotating. This swirling of water is called the "Swirl Effect."

By designing and building a model water turbine with a counter-rotating blade placed behind the primary blade, I was able to use this swirling of water to increase the energy production of the water turbine.

A testing aparatus was constructed to keep all conditions constant during the testing. Three double bladed water turbines with 30, 45, and 60 degree blade pitches were also constructed.

The testing of the model water turbines was done using a 120 cm. length of nylon thread, a 100 g. weight, and a stopwatch. A thirty centimeter distance was marked of on the thread, and the 100 g. weight was attached at the end. The thread was then attached to the axle of the blade being tested. As the blade rotated, the weight was pulled from the floor. A stopwatch was then started at the beginning mark of the 30 cm. length, and stopped at the end of the length. The time, distance and length was recorded and calculated as power (gram centimeters per second). Testing for each blade was repeated thirty times, then averaged.

The power of the double-blade water turbine system proved to be up to 26.5% more energy productive than two single-blade water turbines.

*Second Award - American Intellectual Property Law Association
Alternate - U.S. Department of Energy Trip

THE WING OF THE FUTURE

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By building two similar radio controlled models, one with a forward swept wing, one with a conventional straight wing, and comparing them in basic maneuvers, the purpose of this study was to domonstrate the superiority of forward swept winged aircraft.

Forward swept wing and conventional straight winged radio control model aircraft perform about the same as far as basic maneuvers are concerned. However, the forward swept wing has a greater speed range than the conventional straight wing aircraft. Not only can it go faster, but it can also go much slower.

By sweeping the wing forward it can fly faster by fooling the air into believing that the wing is much thinner than it really is, which results in less drag and higher airspeeds.

It can fly slower because the flight characteristics of a canard prevents wing stalling prior to canard stall, resulting in a porpoise effect. In conventional aircraft, it is common for one wing to stall prior to the other, resulting in a violent snap roll effect. This usually places the aircraft into a spin situation. The forward sweeping of the wing channels the airflow inward toward the wing root. This allows a much higher wing loading before canard stalling.

With the data being obtained from tests, the forward swept wing aircraft appears to be the next stage in high performance military aircraft.

SPIDER SILK MONOFILAMENT: A STUDY OF THE MECHANICAL AND CHEMICAL

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Being a continuation of last year's research, it was decided to compile the data of the mechanical behavior of the Nephila clavipes spider silk monofilament and pursue the chemical characteristics of the protein fibroin. In order to investigate the mechanical properties of the monofilament, the initial focal point was in differentiating linear from nonlinear viscoelasticity. A tensile testing apparatus was engineered and constructed. Ten strands of monofilament were extracted; each strand was attached with epoxy to cardboard tabs. A set of weights, ground from washers, ranged from 0.1 g to 5.0 g. The load was systematically accumulated by manipulating the mass to a hook affixed to a tab. After each load application, elongation was observed, measured, and recorded every 300 s x 4. Rupture elongation was achieved at 0.9, 3.6, and 4.2 grams. Electron micrographs confirmed fibroin diameters of 2u, 8u, and 10u. In pursuing the chemical characteristics of the fibroin, each silk sample was submitted to amino acid analysis. The dry phase hydrolization was used to prepare the samples for testing. Three - ten meter samples of silk were placed in a vacuum for 48 hrs. at 110^0 C; therefore, breaking the tetrapeptide bonds. The samples were placed in the analyzer and the results were compiled. Applications include synthesizing "super tenacity" protein fibers with high strength spider silk. In rehabilitative medicine such fibers could replace muscle fibrils. Testing an index for "strong" and "weak" silk would benefit the textile industry.

COMPUTER INTERFACED ROBOTICS

Don Bowling
Jac-Cen-Del High School
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Although robotics are currently being used in various phases of industrial production, they will eventually be a part of our everyday life at school as well as in the home.

This project is an attempt to construct a pneumatic robotic arm that could be programmed and regulated by a self-designed interface and a typical home computer.

The operation of my robotic arm is regulated by a self-designed interface operating from an input/out socket of a home computer. The computer operates as the "brain" for the arm as it interprets the messages from the program. The program is written in BASIC which uses the input from the switches to make the decisions.

The pneumatic arm has three functions: A)up and down, B) left and right, C) open and close. The input has three switches mounted on the arm to govern the desired command. The output was accomplished by one stage of amplication and then to relays which controls solenoid valves.

The robotic arm is a functional device that is capable of performing simple tasks. I was able to incorporate engineering, robotics, electronics and the use of a computer into the construction and operation of this device. With additional design and programming the robotic arm can be expanded to perform additional functions.

* A CONTROLLED MANIPULATOR FOR QUADRIPLEGICS

Cameron, Stephen M., Evergreen H.S., Metamora, OH 43540
305 West Morenci St., Lyons, OH 43533

The need for a device that is easily controllable and one that a person could be quickly trained to use, became evident after speaking with a man who, due to an accident, became quadriplegic. The need was stressed for a device that would allow him to perform some of the simple functions that he had lost. Such simple functions were scratching one's nose or leafing through a book. After the conversation, construction on a twelve function "quick train" arm began. The arm was designed to be an easy means for a handicapped person to manipulate objects. The arm mimics the human arm's actions and range of motion as closely as possible. Manual tests were performed on the arm to see that all functions were in proper working order. While talking with the quadriplegic it was noticed that he had complete control of his tongue and mouth. Using this observation, a control device was designed that would utilize the controllable movements of the man's tongue. The control device consists of a casted plastic mouth piece with control switches embedded into the upper portion of the plate. Using this mouth controller in conjunction with the "arm" the quadriplegic can use his tongue to cause the arm to move into any position. This allows the user to perform some of the simple functions that were lost. Tests showed that the time needed to train a patient to use this device was significantly low compared to other devices, thus the name "quick train" arm.

*First Award - BDM Corporation
Fourth Award - ISEF/Engineering

THE ENFORCER-A MULTIPURPOSE MAGNETIZER

PUFF, DALE II
GOVERNOR THOMAS JOHNSON HIGH SCHOOL, FREDERICK, MD 21788
10825 POWELL RD., THURMONT, MD. 21788

THE PURPOSE OF MY PROJECT IS TO DEMONSTRATE THE ADVANTAGES OF THE MAGNETIZER WHICH I INVENTED. THE MAGNETIZER CREATED BY MYSELF WILL CREATE A PERMANENT MAGNETIC FIELD AROUND ANY IRON OR STEEL TOOL. IT IS SMALL AND LIGHT, YET POWERFUL ENOUGH TO BE USED IN SUCH FIELDS AS CONSTRUCTION OR INDUSTRY. FOR EXAMPLE, A CONSTRUCTION WORKER COULD SIMPLY HOOK THIS NEW DEVICE UP TO HIS SMALL MOTORCYCLE BATTERY CARRIED ON HIS BELT AND USE IT FOR SUCH PURPOSES AS MAGNETIZING SCREWDRIVERS OR OTHER SUCH TOOLS. IT IS MY BELIEF THAT SUCH A DEVICE COULD SELF-EXPLAINEDLY BE MANUFACTURED AND SOLD ON THE HOME MARKET FOR A LOW PRICE OF SOMEWHERE AROUND TEN DOLLARS. IT SEEMS CLEAR THAT ANYONE DECIDING TO PURSUE SUCH AN ENDEAVOR COULD CREATE A LARGE PROFIT MARGIN FOR HIMSELF. TO FURTHER EXPRESS THE ADVANTAGES OF MY NEW INVENTION, I HAVE ATTACHED IT TO MY COMPUTER, WHICH MONITORS EACH TEST AND CAL ULATES SUCH DATA AS FIELD STRENGTH AND THE DURATION OF THE TEST. THEN, IT UTILIZES THAT INFORMATION TO GRAPH THE DATA, PRINT OUT THE TEST RESULTS, AND STORE THE INFORMATION IN MEMORY FOR LATER USE. THEN, WHEN GOING BACK OVER EARLIER TEST RESULTS, THE OBSERVER COULD MORE EASILY COMPARE THE INFORMATION AND USE IT.

THE USES ARE ENDLESS AS IT CAN BE USED
WHEREVER A MAGNET IS NEEDED.

SMART ROBOTICS

Weishaar, Kevin J., Harding Co. H.S., Buffalo, S.D. 57720
HCR 66 BOX 33, Sorum, S.D. 57654

Robotic devices are constantly being improved, and the implementation of such devices into many phases of our lives is on a constant increase. To enhance robotic operations, a computer can be used to improve effectiveness. The project demonstrates that certain use of computers to enhance robotic operations.

When the appropriate enabler switch is turned on, one of the axes is able to operate through the use of the polarizer toggle switch. When an axis reaches the end of its stroke, a contact is depressed or pressed, therefore sending a signal to the computer. When the computer receives this signal, it will employ a visual indication to tell the user that the certain axis is at the end of its stroke.

The robotic arm will raise 2.5 inches above ground zero, it will extend 2.75 inches, it will rotate 360 degrees, and it has an optimal gripping size of 0.5 inches.

From my experiments, I have concluded that computers can enhance the operations of a robotic device. The application of computer enhancement could be used anywhere a robotic device is used so that the device can be monitored by a screen rather than by an immediate operator.

WATER WHEEL EFFICIENCY

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Purpose:	To investigate the effect of paddle surface area in contact with water flow on the efficiency of water wheels as measured in voltage production.
Procedure:	Design test station, wheel mount, and water wheels. Preliminary experimentation. Redesign test station and water wheels. Measure and record voltage output for each wheel. Repeat until same maximum is obtained a minimum of three (3) times. Record, graph and analyze data. Draw conclusions.
Results:	Greater paddle surface area in contact with water flow improves efficiency to a stop point.
Conclusions:	Water wheel efficiency is improved by means of increased paddle surface area in contact with water flow to a stop point. Hypothesis for stop point: once constant contact with water flow is achieved, no greater efficiency can be obtained by this means. Further investigation needed.
Application:	A simplified and enhanced understanding of the design parameters of efficient water wheels could increase the effective use of this relatively clean and available power source.

THE MAKING OF A MULTIPURPOSE ADHESIVE FROM THE RESIN OF CLUSIA ROSEA JACQ FRUITS TO BE USED IN SOME ASPECTS OF THE CONSTRUCTION IN PUERTO RICO

Nazario, Silvia J., Lola Rodríguez de Tió H.S., San Germán, P.R. 00753
Parcelas Minillas #126, San Germán, P.R. 00753

Knowing the necessity of lowering the cost of the construction in Puerto Rico has driven me to investigate on a possible multipurpose adhesive. This project is dedicated to elaborate a powerful adhesive that could be used in concrete, wood, plastics and glass at the same time. knowing that the fruits of Clusia rosea jacq were of practical use to the Taino Indians and our ancestors, they were selected for this project.

The experiment was concentrated in using the resin from the fruits as a main raw material. This complex hydrocarbon, which is very flammable, was passed through the process of polimerization by using heat. The resulting heavier compound with excellent adhesive properties, dried immediately when put in contact with the air. Additional research with different solvents was done in order to find a practical drying time. It was found that the polymer was not soluble in water; it was in ethanol, methanol and acetone. Since some of the mixture of the solute and solvent dried too fast and didn't permit the use as an adhesive, the amount of the solvent was increased by five ml. at the time. With ethanol the best mixture found was 50g of polymer with 15ml. of ethyl alcohol 70% and with methanol the best mixture was 50g of polymer and 20ml. of methyl alcohol-anhydrous. These mixtures gave excellent results gluing bathroom ceramics to cement, plastics water tubes together formica to wood and glass to glass. It is concluded with this that one adhesive can solve four problems. It is not known in what percentage, but it will save money to have an adhesive with these properties.

Can Two Interfaces be linked into one that will run two machines?

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The research that I conducted this year was a continuation of the research that I began last year. Last year I worked with the problem of making a factory run in consecutive order and I succeeded. The only trouble that I had last year was an overabundance of computers and interfaces. I did not enjoy having to use so much equipment, because it was bulky and hard to handle. I decided that this year I would build a new factory and try to limit the number of computers and interfaces used. I devised a method of reaching this goal and that is the topic of my project this year. I wanted to know if two interfaces could be replaced by one interface that was the same make and model, but was wired differently. I proceeded to build the factory and the new form of interface linking. I also wired the machines the standard way as a control setting to gauge the success of my experiment. After completing the construction of the factory, I did the experiment. I ran the individual machines through the direct hook-up fifty times and both the Band Saw and the S.W./P.C. ran perfectly. I then ran the machines through the combined linkage experiment fifty times, and they performed superbly. With only a small complication in the combined linkage experiment, I concluded that the linkage did work and that it was possible to combine two interfaces into one so that one computer could replace two.

DEVELOPING A HIGH SPEED PASSENGER TRAIN

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The Metropolitan Special was designed to be able to provide high speed passenger rail service on conventional North American tracks with the least amount of expense. To demonstrate this, a HO scale (3.5mm=1ft.) model was built, with a consist of one A-unit locomotive, one B-unit locomotive, one coach, and one observation-lounge car.

A passive-tilt system was developed and employed on the Metropolitan Special. Unlike other tilt systems, the Metropolitan Special's makes no use of computerized sensors or air-controlled springs. The Metropolitan Specail's tilting system is controlled by the centrifugal forces acting on it when rounding a curve. Tests showed this system to be quite effective, with no noticeable delay in tilting when the train enters of exits a curve. The tilt system would allow the train to travel at speeds approximately 20 miles per hour faster around curves than conventional equipment, with no discomfort to the passengers.

Various streamlining techniques were also used on the Metropolitan Special to reduce wind resistance and therefore save fuel. The model was run through several wind tunnel tests, and the resualts were compared with those from tests on a conventional passenger train. Relatively simple calculations show that the streamlining techniques used significantly reduce the amount of fuel needed to pull the train.

SOLAR FLIGHT

Herath, Jeff
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Previous solar aircraft had been only marginally successful. After two years of research and experimentation, I have made giant steps forward in design and performance. The Sunseeker II design balances light weight with strength, yet provides maximum lift. This year I drew my design on the CAD (Computer Aided Drafting) system for more accurate drawings. My design is the first to use flexible solar cells, which can be molded to an efficient airfoil. The design of the airfoil was chosen after I calculated the aspect ratio and the Reynolds number of the wing for the proposed air speed. Sunseeker II also uses my diode gateway original design which solves the problem of previous solar aircraft not being able to maintain power. I used three diodes to create a circuit board which directs the available power. Two of the diodes decide which power source (solar cells or batteries) has the greatest voltage and uses that one to run the motor. The third diode allows trickle charge from the solar cells to recharge the batteries. This enables Sunseeker II to fly indefinitely and more reliably. To construct the plane, I selected materials according to weight and strength. The drawings were enlarged to actual size and used as patterns for cutting and meticulous construction. In test flight, I was checking the balance when it accidentally crashed after 20 yards of flight. Sunseeker will fly again.

#First Award - National Aeronautics and Space Administration
Third Award - ISEF/Engineering

IS PHOSPHATIC CLAY A GOOD BUILDING COMPONENT ?

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This study was designed to determine the usability of phosphatic clays (mining waste) as a structural component for building . Clay slurry was floculated by using P.E.O. Clay was formed into blocks . The blocks were then divided into two equal groups . Blocks were fired at 200C, 500C, and 800C. Greenware was used as a control. Initial data shows that there is only a few percent of solids in the suspension , depending on location of sample . Permeability tests show the following:

a) greenware is totally destroyed
b) 200c eighty to ninety-five percent destroyed
c) 500c and 800c seemed unaffected

Compression strength tests were performed and two conclusions were found . The 200c tiles were the most compressible . 500c and 800c tiles did not compress . They fracyurd instead.

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* The Diagonal Network

Ali R. Alaie
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Convential single-processor computers attack problems sequentially, or one step at a time, making them too slow for most scientific applications which often require billions of operations. To achieve greater speeds new and more advanced architectures must be employed: in particular parallel processing, which is the chaining of two or more single processors to produce a faster and more efficient computer.

There are basically two types of parallel processors : Single Instruction Multiple Data stream (SIMD) and Multiple Instruction Multiple Data stream (MIMD). In the latter, all of the processors share a common memory bank and are connected to it via a switching network. In essence it is the strength of the switching network (by strength I mean its ability to handle a great number of interconnections without overloading) and not that of the individual processors that determines potential speed of the computer.

My research involved the study and analysis of these networks by simulating them on other computers and determining their strengths and weaknesses, the result of which was the design, testing and analysis of a more efficient and cost-effective switching network which I call The Diagonal Network. A Diagonal Network computer built with 64K processors would oppearte at roughly 40-42 Billion Instructions Per Second (BIPS) making it, by a margin of nearly 250 percent, the fastest computer in the world. I have applied for pattents on the design and hope to be able to build such a computer within five years.

*First Award - Federal Aviation Administration
Second Award - IEEE Computer Society
Third Award - ISEF/Engineering

DIGITAL SAMPLING: THE EFFECT OF RESOLUTION AND SAMPLING RATE TO QUALITY OF SOUND

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Digital sampling is the process in which an analog input (voltage/current) is changed into a digital form of which the computer can understand. The process is done with an analog-to-digital convertor (A/D convertor). The digital information can be altered to make many different varieties of effects, but errors may occur in the process of converting caused by low resolution or a low sampling rate.

The purpose of my project was to find how these errors would affect the quality of sound. I determined the effect by using the digital sampler and analog box which I made as well as the software which I programmed.

In the project I have sampled different types of sounds (like voices and sine waves) and then lowered the resolution and the sampling rate. Finally I compared the distorted sound with the originally recorded sound.

Through the results of the experiments, I concluded that the distortion was constant throughout all sounds when the resolution was lowered, but the distortion was greater at higher frequencies when the sampling rate was lowered.

The information that I have gathered can be used by the sound engineers to determine the minimum sampling rate and resolution when building digital sampling products.

CAD/CAM ON THE HOME COMPUTER

MATTHEW ROCHE
HOLY ROSARY COLLEGE, MOUNTBELLEW, CO. GALWAY.
GURTEEN, BALLINASLOE, CO. GALWAY.

CAD/CAM stands for Computer Aided Design to Computer Aided Manufacture. The aim of the project was to provide a direct replacement of a Manufacturing Technique used in Industry called CNC or Computer Numeric Control. This system is in five stages, is prone to user errors and is an extremely long process. The CAD/CAM system, on the other hand, is more compact and efficient and reduces the process to two stages. The Designer designs his component and it is then automatically manufactured by the computer. The project involved the use of three disciplines which were computers, electronics, and mechanics.

To support my project, I built a working model of a CAD/CAM system for use in industry. It is a machine table which provides a flat work bed which is under total control of the computer.

Applications for a system such as this are limited only by the imagination. There are applications in engineering, car manufacturing, textiles and knitting machines, for example.

*Third Award - ISEF/Engineering
Third Award - Society of Manufacturing Engineers

A FOUR YEAR STUDY ON THE HEAT EFFICIENCY OF WOOD, INVOLVING THE ANALYZATION OF MINERAL CONTENT IN THE RESIDUE.

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Many homeowners are converting from electrical heat to natural heat. This led me to the purpose of my research. To begin my research I visited a sawmill from where I purchased my wood samples. These were all 15% moisture content. I then constructed a stove to analyze my wood species. To start the burning process I cut each piece of wood to equal 12 oz. and burned it in my stove for one hour. Temperature was recorded on the chimney, stove and water at 10 min. intervals for one hour. The water in the calorimeter was 30 deg. C and was replaced with 2 1/2 cups of new water after each burn. The heat efficiency of wood is the most important aspect of this material. However, to continue my project I analyzed the mineral content in the residue. To start the testing I spent a day in a soil testing laboratory. Preparing the ash for the mineral content testing was very important. I first measured one gram of ash into a flask and added 25 ml. of hydrochloric acid. I then boiled the solution to extract the mineral from the ash for 30 min. When the boiling was completed I filtered the solution into a test tube and added a chemical called Barton's Rageant, to give the solution a yellow color, depending on the mineral content of the residue. I tested for Phosphorus, Potassium and Calcium on two different machines. Both mineral content and heat output make up the best efficiency.

HOT AIR ENGINE

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The principle of this project is based on Kelvin's Law, which states: When any gas is heated to 473 degrees Kelvin, it will double it's volume.

This is how the engine works: When the air inside a nearly airtight chamber is heated, it expands its' volume and pushes a small piston out a tube soldered on the side of the chamber.

The piston is attached to a flywheel by a connecting rod. When the piston is forced out, it turns the wheel. A displacer inside the air chamber is connected to the wheel by another connecting rod. When the wheel turns, it moves the displacer inside the chamber. The displacer pulls the air to the top of the chamber where it is cooled. The air then contracts and pulls the piston back.

The purpose of this project was to find a cheap energy source with no pollution. An engine the size of this model does not put out enough power to do any work that would be of much value. However, the same engine a few times larger would put out enough force on the wheel to do some significant power.

The materials used for this project are really quite simple. The main engine consists of such things as an empty aerosol can, a tube from a shock absorber, and two empty beverage cans.

NUMEROUS-IN-ONE DEVICE

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A unique and simple device involving low cost construction materials was designed and developed to answer the quest for energy conservation and financial demands of developing countries. This is composed of five different components that can be assembled as one and can function simultaneously with the use of a single load of charcoal. The first component is the main cooker which serves as an oven, broiler and steamer. The second component is the extension cooker which performs rice cooking, water heating, frying and other cooking purposes. The third component is the flat iron power base, the fourth is the food drier which can also serve as a food warmer, and the last is a water purifier which is composed of filter, boiler, and cooler tanks. These components were assembled in a suited iron stand holder. In determining the efficiency of the device and its insulation, test using different types of charcoal were employed considering the amount of temperature, amount of charcoal and time elapsed. Analyses of results were done using appropriate statistical treatments whereby the significant difference on the efficiency of the device with and without insulation as well as the non-significant difference on the use of different types of charcoal were proven. For further analysis, the device's performance was compared to commercial device using LPG and electricity. Hence, the "Numerous-In-One Device" was found as effective as the latter but more economical.

#Alternate - U.S. Department of Energy Trip

THE EFFECTS OF ADEQUATE ATTIC INSULATION

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One day I was driving around and wondered why some roofs have a lot of snow, some ice, and some no snow. So, the point that I am trying to prove with my experimint is that if you have adequate attic insulation you will not only solve snow melting and ice buildup due to heat loss, but you will also lower cooling costs in the summer.

The main material I used for my project is a type of styrofoam called "Certifoam". This kind of insulation has an R value of six and is very durable in construction. After I cut this foam, I fitted and glued it together, and I used plexiglass to cover the front of the project so that you can see the thermometers which I used in the various rooms. I also used some light paneling, some regular shingles, and two forty watt and two one hundred-fifty watt light bulbs.

If you look at the thermometers inside the rooms and attic, you will see a difference in the temperatures. This difference is due to the amount of insulation in the ceilings.

My model works and is reasonably accurate. It works good because of the construction and the insulation that I have used. It also works good because it backs up the theory that adequate insulation affects heating and cooling of the home.

There are some variables that make my careful calculations off a little bit. One factor is the plexiglass. It lets lots of heat out of the rooms and also transfers heat and coolness from room to room. There also might be differences in the thermometers and light bulbs.

ACE - THE SONIC WHEELCHAIR

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ACE-THE SONIC WHEELCHAIR is a project designed to combine the technology of the computer and robotics with the function of the wheelchair to add a new dimension to the modern day wheelchair with efficiency. It is composed of seven main circuits: the "brain" circuit, the servodrive circuit, the soniscan circuit, the external-communicator circuit, the audio-generator circuit, the event-timer circuit, and the battery monitor circuit. Each circuit consists of subroutines that help provide the wheelchair with sight, hearing, sound, direction, commands, and a sense of decision making. Two additional circuits that play a major role in the working abilities of this project are the manual programmer and the tape interface. Together, they provide the project with a set of instructions to operate by, storage area, and retrieval ability. The unique combination of these circuits along with the mechanical design of the wheelchair creates this, the one and only ACE - THE SONIC WHEELCHAIR!!!

#Third Award - ISEF/Engineering

PHASE III: THE INTEGRATED STRAIN GAUGE BIRD SCALE

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The engineering purpose of this project was to completely redesign and greatly improve the accuracy, precision, and magnitude of the prototype. The project was also designed so that the device would accurately weigh a bird, or possibly other vertebrae, in a non-threatening manner without regard to the environment.

From previous phases of this project it was concluded that the device is practical and more convenient over the conventional methods in practice. It was also concluded that the birds show no fear of the device. The previous prototype also allowed a measurement of weight indicating the volume of seeds consumed.

The accuracy of Phase III was improved tremedously, along with the precision and magnitude, over the preceding two prototypes.

#First Award - ISEF/Engineering

CONSTRUCTION OF AN ELECTRO-MECHANICAL, RADIO-CONTROLLED, COMPUTER BASED ROBOT.

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973 Hugtussle Road, Gamaliel, Ky. 42140

Prior research with other electro-mechanical devices convinced me that an electro-mechanical computer programmable, remote-controlled robot could be constructed by the common layman with common everyday materials purchased locally.

Trial and error was used in building the various parts of the robot. The main construction material used was aluminum tubing fastened with pop rivets. The robot is capable of being controlled by either a radio-controlled device or by the on-board computer, both of which energize the coils of two double pole double throw relays, the polarity being switched on the second relay to provide reversing of the motors.

The project is completed and working as expected. Future work includes incorporating a wireless voice synthesizer.

#Fourth Award - ISEF/Engineering

* DIGITAL ELECTRONIC MAP MEASURER

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England. LU7 OLE

The decision to build a digital electronic map measurer originated from difficulty experienced in using a standard mechanical map measurer because of its shape, and also because it was not easy to convert the reading into miles or kilometres for the appropriate scale of map.
The device which I have designed to overcome this problem consists of a hand held box of electronic circuits connected to a small pen-like probe with a rotating wheel at one end.
The probe is held like a pen and moves across the surface of a map so that the wheel rotates. The electronic circuit records the distance travelled by the wheel and the reading is displayed on the digital readout in the box.
I built the measurer for my sixth form project in seven months at a cost of £150.
The device can be used on any scale of map and it has the facility to display the distance in miles or kilometres. It is also possible to re-trace the route taken, that is to count down as well as up, and the device can be reset to measure a different route. It is accurate to the nearest millimetre of map measurement.
The Digital Electronic Map Measurer could be contracted to the size of a ballpoint pen and marketed in this form. A search has failed to reveal any similar product on the market, and steps have therefore been taken to patent the idea.

***Second Award - Patent and Trademark Office/U.S. Department of Commerce/Patent and Trademark Office Society**

Third Award - ISEF/Engineering

Designing, Building, and Testing an Anhydraus Applicator Blade.

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The application of ammonia is an essential component of all farming operations. The purpose of this project was to design, build, and test a cost efficient applicator blade that would not experience clogging of the dispensing tube in low pressure use.

It was hypothesized that a down-sized blade with a combination of rear earth flares and a fore earth displacer would perform best under testing. This design would not experience tube stoppage and could be fabricated at a lower cost than the standard blade.

The results of the experiment indicated the standard blade's dispensing tube was clogged with eight gallons of water remaining in the tank. The blade with only the fore earth displacer was clogged with soil with 7.6 gallons of water remaining in the tank. The tube of the blade with only the rear earth flares was clogged with soil with 7.6 gallons of water remaining in the tank. When the blade with the combination of the fore earth displacer and the rear earth flares was tested, the tank was completely emptied.

It was concluded that the blade with the combination of the fore earth displacer and the rear earth flares experienced less tube clogging in low pressure use. The down-sized combination blade could be produced at a relatively low cost in comparison to the standard blade.

THE EFFECTS OF WAVE INTENSITY VARIATION ON THE EFFICIENCY OF AN EXPERIMENTAL SLOPE VALLEY SEAWALL

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Wave forces are detrimentally affecting the overall landscape of coastal regions throughout the United States. Subsequently, the total land surface has decreased at an alarming rate. To extend the lifespan of beaches, artificial structures have been positioned in the vicinity of the shore to deflect the bulk of the wave energy.

This research is concerned primarily with the fortification known as a seawall. This structure can effectively protect the backshore; however, the land in front of the seawall is usually subject to more intense wave action. In which case, it hinders instead of helps.

In Phase I of this project, an attempt was made to solve this problem by creating a new seawall design that would be able to absorb most of the force. This design was named "Slope-Valley Seawall". It consists of a 270° inner valley, a 45° forward slope, and an overhead incline. It proved to be more efficient than a combination curved and stepped-face seawall.

In Phase II a modified version of the Slope Valley Seawall, featuring a 25° forward slope, was tested to determine how efficiently the seawall functions under wave conditions of variable intensity.

By determining the wave conditions under which the seawall will be most efficient, the location that the Slope-Valley will be most adept in protecting the shoreline can be ascertained.

#First Award - American Society of Civil Engineers
Second Award - Bureau of Reclamation/U.S. Department of the Interior
Fourth Award - ISEF/Engineering

ANALYZING THE EFFECT OF TRAFFIC LIGHT DURATIONS ON TRAFFIC FLOW USING COMPUTER SIMULATION

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The purpose of this project was to develop a program that simulates the traffic flow through a four-way intersection. Then, a mathematical formula was derived to find the traffic light settings that produced optimum traffic flow. The simulator was used to verify the formula, and to find the effect of changing light duration on traffic flow.

The simulator uses discrete system simulation technique and statistical theory. To verify the validity of the output, graphs were made to see if random distributions were correct, and observations were made on real intersections to make sure that certain assumptions made were valid. Then, after a formula was derived, data about traffic light settings and traffic arrival patterns of two intersections was obtained. Using this data and the derived formula, traffic flow of the selected intersection was simulated, and theoretical optimum settings were compared with actual traffic light settings.

This study has several applications: it, of course, is of value to traffic control engineers. Smooth, efficient traffic flow is essential to a growing urban center like greater Washington, D.C.. If optimum traffic light settings can be found for certain arrival rates, inexpensive timers can be used in place of expensive sensors and detectors installed at the intersection. This project also demonstrates the value of computer modeling; without the simulator an expensive and time-consuming investigation watching real cars, or a real-time hand simulation, would be necessitated.

KEEPING THE CAMARO

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One of the greatest potential expenses in college is transportation. Bicycles can accommodate a good deal of the on-campus traveling, but they lose their appeal on intra-city jaunts of several miles or more. Cars are appropriate and necessary in situations like these, but unfortunately, even a car requiring only minimal maintenance can wreak havoc on a college student's budget.

The goal of the work performed in this study is to develop a commuter vehicle that can meet the needs of the college student. The design goals established for the vehicle are as follows:

1) initial cost: $200
2) cruise speed: 40 mph
3) range: 5 miles
4) operating cost: 0

The vehicle being developed is an experiment in the transportation applications of kinetic energy storage. A thin-rim type flywheel was constructed using layers of 3/4" steel ribbon and a magnesium alloy bicycle rim. The flywheel was then incorporated into a commuter vehicle using a three speed transmission, bicycle chain drives, and an idler pulley for power transmission. Photovoltaic cells and a 10,000 RPM electric motor are used to charge the flywheel.

Most of the design goals have been met, and the commuter vehicle may prove to serve its function well. I currently own a Camaro. I love it, but I can not afford to drive it in college. Now that an alternative commuter vehicle has been developed, I can go to college and keep the Camaro.

#Second Award - Patent and Trademark Office/U.S. Department of Commerce/Patent and Trademark Office Society

POLYSTAGE, NON-SATURATINGTING, FIBEROPTIC ISOLATED MAGNETO-MASS-ACCELERATOR

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The magneto-mass-accelerator (MMA) is an electromagnetic technique for rapidly accelerating a mass to some high velocity. In principle MMA is much like the railgun which has long been under development as a technique to possibly replace the high power conventional gun or simple rocket motor for accelerating a projectile or payload to very high velocities. The difference between the railgun and the MMA is one of practicality and implementation. The difference is as basic as the difference between engineering and physics. Physics is the study and establishment of physical laws. While engineering is the application of these laws.

The railgun offers a pure physics approach to the use of high magnetic fields to accelerate a mass to very high velocities. While the magneto-mass-accelerator (MMA) is a practical engineering implementation of the physical laws governing magnetic coupling and repulsion best explained by lenz's law.

Since the MMA offers a more reasonable set of operating parameters it should replace the railgun even before it finds a common use or application. The MMA is indeed the propulsive technique of the future with special application in such areas as the Strategic Defense Initiative or "Star Wars" and tactical arena in areas such as tank guns. Magnetic acceleration of a mass or payload is now practical.

#Fourth Award - ISEF/Engineering

A MULTI-FACETED APPROACH TO ENGINEERING CALENDERED CELLULOSE PRODUCTS FROM WASTE MATERIALS

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The purpose of this project is to explore, with a multi-faceted approach, the feasibility of using waste materials to develop calendered cellulose products. In this experiment, many aspects have been investigated. The first to be researched was the possibility of producing paper from waste materials. This was proven to be possible by the fabrication of papers from primarily Agricultural wastes in addition to Industrial wastes. The next aspect to be examined was the quality of the paper produced. The most versatile papers were proven to be those made from cornstalks and sugarcane. This was determined by the various tests to which each paper was subjected. The results of this phase determined the selection of papers in the following aspect, the proposal of various products made from waste materials that could be considered for commercial production. The final aspect involved testing for the feasibility of potential materials that possessed competitive attributes when compared with the commercial output of virgin pulpwood. This investigation includes the development and implementation of test plots, the measurement of field samples and development of mathematical models through the use of random number generation. At present cornstalks are proving to be highly productive but sugarcane, though only in its first year of study, may exceed the current productivity of cornstalks. The incorporation of kenaf, another promising material, is planned in the near future.

#Second Award - ISEF/Engineering

#MOBILE ROBOTIC INDEPENDENCE, PHASE II

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The popularity of robots is constantly increasing as technology progresses. Most of today's robots are stationary and perform in factories where mobility is not necessary. However, mobility is necessary to overcome the confinements and limitations that stationary robots encounter. In order for a mobile robot to be practical, it must be capable of functioning on its own; consequently, the purpose of my project is to design a robot that can operate independently.

To achieve independence, the robot must be able to sense its environment. This entails including sensory functions for navigation and recharging. To navigate, the robot was equipped with sonar and collision sensors, and to detect its charger, a light sensor was installed.

For practicality and convenience, the robot and its operator must be able to communicate. The robot receives instructions from its operator through a hand-held wireless keypad. To express its status, a voice synthesizer was included, thereby establishing mutual communication. Many methods were used to improve the robot's accuracy and speed; one of which was constructing a computer dedicated entirely to the control of the drive motors. To ensure equal speeds between the drive motors, an innovative equalizing drive mechanism was employed. In order for the robot to measure distance displacement, an encoder wheel was used.

By using data supplied from its sensory devices, the robot was able to perform its original intentions of independent operation. With the completion of this project, the initial step for constructing any mobile robot is also completed.

#Second Award - Institute of Electrical and Electronics Engineers
Third Award - ISEF/Engineering
Honorable Mention - National Aeronautics and Space Administration

MORE FOR LESS: OPTIMIZING TRACTOR EFFICIENCY

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Maximizing efficiency of heavy equipment is an integral part of cutting operating expenses in today's rigid agricultural industry. Optimizing wheel slippage is the most effective means to accomplish this goal. This project employs the use of a model to find the slippage value having the highest efficiency.

An underweighted tractor wastes power by spinning its wheels. However, an overweighted tractor also wastes power by carrying excess weight. The goal is to capture lost horsepower by weighting the tractor properly, or by finding the best slippage value. The GRETTA model is interfaced to a computer which monitors its slippage through the use of infrared sensors. The "optimum" slippage value is found by measuring GRETTA'S efficiency with various weight distributions. The model is designed so that an electromagnetic clutch automatically engages the front wheel drive when slippage exceeds a set value. It was found that the desired percent of slippage increases as soil becomes coarser.

An average farm business could easily save several hundred dollars each year in decreased fuel consumption and decreased tractor wear by putting this technology to use. The knowledge could also be employed in operation of military tanks, bulldozers, tractor-pull tractors, and automobiles. The infrared monitoring system could easily be adapted for use on an actual piece of machinery.

A TWO YEAR STUDY ON THE COMPARATIVE MATERIAL EFFICIENCY OF BEAMS

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This project is the result of two years of study on truss and girder beams and bridges. The first hypothesis is that all of the tested trusses will have a higher material efficiency than the tested girders. Another hypothesis is that the 45 degree trusses will have the best material efficiency. Material efficiency is defined as the deflection per unit mass. The beams were tested by loading with up to 3 kilograms of weight. The deflection was measured with a dial indicator. The mass efficiency is found by the following equation:

$$MEb = Df / Mb$$

with MEb being the material efficiency of the beam, Df the deflection in millimeters, and Mb being the mass of the beam.

The deviation of the gathered data was found by using equations to find the average absolute percent deviation. After these calculations were completed it was found that the average absolute percent deviation was only 2.018 percent, proving the data to be excellent.

A TURBO Pascal program, written by myself, was used to perform all of my calculations. All that was required was that the deflection data be entered. The program performed all of the required mathematical computations including the average absolute percent deviation.

After extensive testing, it was concluded that the trusses with the 45 degree angled members had the best material efficiency.

ADVANCED COMPOSITE MATERIALS

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This experiment was concerned with demonstrating that today's modern composite materials can be used to construct efficient aircraft wings. A 1/5th scale F-5E model wing was constructed and tested. The results were compared to a metal wing.

S-2 Glass, Kevlar, S-2 Glass/Graphite, Graphite, and Kevlar/Graphite fabrics and Pre-preg Graphite unidirectional tape composite materials were evaluated by tensile testing. Test specimens were constructed in the same manner as the model wing. The advantages and disadvantages of each individual material were determined. A "custom" material was then defined to provide the best overall design features.

Epon 826 epoxy was selected for bonding the fabric layers, using a wet layup vacuum bagging process. A six pound/cubic foot structural polyurethane foam was selected for the wing core.

The model wing was constructed using seven layers of material. Hybrid Kevlar/Graphite (HKG) was bonded directly to the foam core. Kevlar was selected for its toughness and light weight. Three layers of unidirectional Graphite tape were used over the HKG layer to provide high flexural stiffness. Three layers of S-2 Glass fabric were used over the Graphite to provide a good finishing material for grinding and sanding.

The wing was load tested to determine its beam stiffness and wind tunnel tested to verify its aerodynamic characteristics. The composite model wing was 20-25% stiffer per pound of material than an equivalent metal wing. The composite model wing lift and drag characteristics were in the same range as published results for similar wing geometry.

#Third Award - ISEF/Engineering

COMMUNICATION BY LASER

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One of the most important uses for a laser is for communication. This project is to find the different methods and the principles behind laser communication. I used scientific procedures to investigate laser communication. I started this project with a modulated laser and a receiver. The modulator inside the laser controls the current to the laser tube, producing a 15% amplitude modulation on the beam. Later I discovered that a piece of vibrating rubber band or tuning fork can mechanically modulate the laser. The beam arriving at the detector of the receiver is in pulse form and the same frequency is reproduced. I then used a speaker covered with cellophane paper, placed it inside a bell jar, and evacuated the jar. The speaker was covered with cellophane paper to modulate the reflected laser beam which will move in a different direction according to the vibration of the speaker. Modulated by a vibrating surface, a laser beam can transmit voice. These three experiments are the necessary developing steps for this project which lasted for almost a year. Many applications can be derived from this project: communication by fiber optics with satellite or submarine; music insturment by pulse modulation; spying be detecting a vibrating window; detection of an unattainable vibrating object on earth or in outer space; and the detection of Brownian movement of water molecules in a weightless state. These ideas are all original. Very few sources are found on this type of project; however, the military may have been applying these methods for several years.

CAN WE BUILD A BETTER SYSTEM

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Scientists and engineers have been working on safe and efficient solar powered heating systems for homes as an alternative to systems using fossil fuels. My project last year compared two solar collector systems, one using freon as the exchange medium and the other using water. The phase change, or freon, solar collector was more efficient than a conventional hydronic system.

The purpose of this project is to test a design change in the heat exchanger of the phase change solar collector to see if it would operate more efficiently. The condensor was modified using two copper tubes connected in six places by short pieces of copper tubing parallel to each other. The liquid flowed through the tubing as it was condensed. This arrangement was used instead of a coil to facilitate the flow of gas to prevent vapor lock.

To test this modification, the temperature was recorded at specific intervals as a tank of water was being heated using the original and modified exchange systems. During the test period, great care was taken to keep all conditions identical. The modified system heated the water more efficiently than the original coil system, therefore, showing thatthe system performed better with the modified heat arrangement.

This system can be used as a primary heating system in the state of West Virginia as in other locations of like climate and terrain. A conventional furnace would be needed as a supplement, but the importance of this is that it can be used as a primary heat source.

HYBRID AEROSTAT MODEL

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I have constructed a model of a hybrid aerostat that on a larger scale would be capable of making a trans-global flight in the southern hemisphere. With this model, I have done a study of weather patterns, atmospheric conditions, instrumentation, communications, living conditions, lifting power, fuel, and other materials needed to fly around the world.

This aircraft would use a combination of a 2 million cubic foot helium balloon and a 1.25 million cubic foot hot air balloon. The purpose of a hybrid system would be to use the hot air balloon in place of sand ballast for verticle control and the helium balloon would supply most of the lifting power.

The cabin of the aircraft would be pressurized and would have enough room for two pilots, three computers, instruments, water, septic tank, electrical production, and food.

The hot air balloon would be heated by nine 122 million BTU burners fueled by liquid propane. A total of approximately 2,000 gallons of propane would be needed to fuel the burners and pilot lights throughout the flight.

All of these components would work together to fly the balloon during the 8-14 days needed to make a trans-world flight.

STEREOSCOPIC PHOTOGRAPHY APPLIED TO VIDEO TRANSMISSION

Sims, Ryan
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Stereoscopic is the correct name for vision with depth. The perception of depth is obtained by having two eyes. Hence, stereoscopic means literally two-vision. Using home video equipment and computer graphics, I studied the ways it would be possible to send different views to each eye from a single television. Using Physics and Electronics, I developed and tested a mechanical device to produce stereoscopic images with one video camera by four geared mirrors. It was possible with this device to calculate the distance of an object from the video camera by adjusting the angle of the mirrors. I designed an electronic circuit that connected to the mirrors and gave out a digital readout of distance measurements as a function of mirror angles.

COMPUTER PROGRAMMABLE CHEMICAL TRANSPORTING ROBOT

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1840 Doris Ave., Grand Haven, Mich. 49417

The purpose of my project is to design and build a computer programmable chemical transporting robot. In addition to this, my robot can carry small amounts of radioactive elements without depleting the electronics in the robot's solid state electrons through ionization or photoelectric effect. This robot has systems ranging from light activated switches to a chemical cooler system.

DOES NITRO-METHANE INCREASE RPM'S AND THRUST

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I conducted this experiment to determine if the percent of nitro-methane in my fuel would alter either the rpm's or thrust of an engine. I hypothesized that the thrust and rpm's would increase slightly with the increase of nitro-methane. My hypothesis was based on reading I had done on nitro-methane.

To test if the percent of nitro-methane would increase rpm's and thrust I designed and built a test stand that would test the rpm's and thrust of an engine. I started the engine and tested five percent nitro-methane fuel, and 15 percent nitro-methane fuel four times each, running each test four minutes long. Each time I recorded the data in my log book. I recorded the thrust in thousandths of an inch. I measured the thrust with a dial indicator. I concluded that my hypothesis was correct.

HIGH FREQUENCY PLASMA SYNTHESIS

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Though generally produced at high temperatures, plasma is described as gases which are under ionized conditions. It is known to be the phase of all matter undergoing nuclear fusion, as well as that of high energy spark discharges and other high temperature conditions.

Nikola Tesla, in his accounts of the energy produced with his huge coils, claimed (with photographic evidence) to have witnessed "ball lightning". Some scientists who have witnessed "ball lightning" believe it to be a form of concentrated plasma.

In an effort to create a concentrated plasma, several Tesla type systems were constructed. These systems consisted of induction coils, capacitor banks, spark gaps, and suitable high-voltage sources.

To be efficient, these assemblies had to be tuned to a resonant frequency. This required the primary tank circuit to resonate at the same frequency as the secondary coil. In this fashion, energy would be transferred to the secondary at precisely the right moment.

A multitude of methods and materials were employed in an effort to reach resonance. Several experts in physics and electronics were consulted as well as experimentation by calculation, instrumental measurement, trial and error experimentation, and literature research.

Secondary coils from 21cm to 143cm were tested, coupled with capacitors of self-constructed plate and bottle types and also large commercial capacitors. Neon sign transformers and a power line transformer were used as energy sources.

Future research in plasma synthesis, after reaching resonance, will include construction of a inductively couple plasma torch.

JOINT SEALS AND THEIR EFFECTIVENESS

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The Joint Seal Experiment determines what types of common materials may be used most effectively to block the emission of high temperature flames and gases. Inspired by the mishap of the Challenger Shuttle, this experiment analyzes the various types of deterioration present and how they may be minimized for practical use.

Tests on each particular type of seal are facilitated through their fitting between two metal alloy joints. This assembly allows for a high temperature stream to pass through, putting stress on the seal. A thermocouple mounted onto the exterior of the joints determines the amount of heat escaping, while a pressure gauge measures the relative amount of stress on the seal. After a predetermined burn time, the tested joints will be disassembled and studied under magnification. This process enables the experimenter to evaluate the effectiveness of individual tests and redesign the assemblies for greater efficiency.

The experiment reveals that each of the joint seals are dependent upon a number of factors: 1) The type and amount of materials used, 2) The temperature and pressure to which it is subjected, and 3) The size of the junction between the joints. Redesigns confirm that a combination of these factors provide the most ample seal and joint protection.

The possibility thus exists for the use of more common, economical materials as seals in thermodynamic systems. When developed, these findings could be applied towards both modern industry and future technology.

#First Award - Vacuum Technology Division of the American Vacuum Society

DEVELOPING A MOBILE ROBOT SYSTEM

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The main objective of this project is to develop an original mobile robot system with a variety of applications. The purpose of this year's project was to design and produce a reliable radio data-link between the mobile robot and its remote computer. All of the software for the system is in C. The software has provisions to detect and automatically handle errors on the data-link. When the software detects an error, it identifies the kind of error and takes the appropriate action to correct it which often means that it re-sends the rejected data. The hardware of the data-link includes multiple microprocessors which maximizes the performance significantly. The MODEM ICs are microprocessors and do all of the signal processing with internal algorithms. The serial control unit on the robot is a microprocessor as well. The development of this radio data-link provided many benefits and satisfied many necessities. With a radio data-link, the robot is able to move about freely without hindering cables. With the design of this radio data-link the robot control circuitry runs no chance of receiving an incorrect command from the remote computer, which is a necessity in a system of this type. With the most important problem of this mobile robot system solved, we can begin to look towards some of its possible applications. The applications are only limited by the mobile robot's mechanical design. This system is heading towards applications in such environments as factories, laboratories, offices, and homes.

#First Award - National Aeronautics and Space Administration

ELABORATION, DURABILITY, STRETCHING CAPACITY OF BLACK RUBBER TO DETERMINE THE DURABILITY AND STRETCHING

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In the elaboration of black rubber and vulcanized rubber, the durability capacity was determined, as was the stretching capacity, using the constant stretching machine (CSM).

In the elaboration of the vulcanized rubber the "Goodyear Method" was used, where two formulas were developed: in formula A, 6ml of Acetic Acid, 3ml of Formic Acid and 7gr of Sulphur; in formula B, 6ml of Acetic Acid, 3ml of Formic Acid and 3gr of Sulphur. The rubber bands made with formula A were heated for 30 minutes at 100 C while those made with formula B were not. In the second phase, the black rubber was elaborated using the following: formula C, 15ml of Benezene and 7ml of Acetic Acid; formula D, 10ml of Benzene and 10ml of Acetic Acid. After the elaboration, the residue of grease, resins and chlorophyll were eliminated by heating the different formulas with 250ml of Ethylic Alcohol at 60 C for five minutes. A spectroscopy was made of the latexes to determine the functional groups present using the bands and peaks obtained in the test. A C.S.M. was constructed where a constant force was used. In the durability test, the rubber bands were heated in distilled water for 30 minutes at 95 C to determine if they resist high temperatures. In the resistance test, when heat was applied to the rubber bands, formula A and formula C, (F_1 and F_2) these exhibited less resistance than those that were not heated.

ELECTROMETALLURGY: PREVENTING CORROSION BY GALVANIC COUPLING

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Dissimilar metals can prevent corrosion by their galvanic coupling. Reference electrode potentials were used to evaluate several metal pairs in tap water and in saltwater. This information was then utilized to determine the most efficient sacrificial anode to provide cathodic protection to valuable structual metals.

For the experiments, galvanic cells were made with four metal pairs (Fe/Zn, Cu/Fe, Cu/Pb, and Pb/Zn) in softened tap water and in saltwater. The metal samples were externally coupled by an 820 OHM resistor to control their galvanic corrosion. By means of a special switching assembly, voltage measurements were taken over a 48-hour period between each metal and a carbon reference electrode in the solution. This information was compared to earlier control measurements of these metals in uncoupled half cells.

There are several conclusions: (1) a metal's corrosion rate can be greatly reduced by coupling to a more active metal; (2) the extent of protection depends on surface changes in the more active metal; (3) zinc protects iron and lead well because of its stable voltage; and (4) in the Cu/Fe pair, solution changes defeat the cathodic protection and increase copper's corrosion. The applications of this data are of great economic significance to the engineer. By using galvanic coupling effectively, corrosion of valuable metals may be controlled in automobiles, monuments, and storage tanks.

WINGS FOR THE FUTURE IV

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Purpose: To determine what effect grooves at varying angles on the upper surfaces of a swept-forward wing have on the lift capabilities of that wing.

Procedure:

(1) The wind tunnel was redesigned to further reduce wind turbulence and provide for more accurate measurements.
(2) Calculations were made to determine the angle at which to sweep the wings forward.
(3) New attachment holes were located and drilled in each wing to enable the wing to be tested in the swept forward position.
(4) Each wing was tested in the wind tunnel for lift capabilities on both low and high fan settings.
(5) Raw data from tests were placed through a conversion equation to establish adjusted data taking into account the differential of weight in the wings.

Conclusions:

The conclusions drawn from this experiment were that Wing Two, which had 45 degree grooves, produced the greatest amount of lift for both high and low fan settings of all four wings tested. Wing Three, which had 60 degree grooves, produced the second greatest amount of lift for both high and low fan settings. Wing Four, which had 75 degree grooves, produced the third greatest amount of lift for both high and low fan settings. Wing One, which had no grooves, produced the least amount of lift.

My hypothesis was supported by the data that was collected.

#Alternate - U.S. Department of Energy Trip

# ENGINEERING OF A TESLA COIL WITH EMPHASIS ON CAPACITOR DESIGN

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High voltage capacitors are used in many industrial tools, particularly in high energy devices such as lasers, X-ray generators, and particle accelerators. This report deals with their development, construction, and testing which could be of interest for the above applications.

The principle behind the capacitors in discussion is simple and has been around since the 18th century. The first capacitors known as Leyden jars, consisted of a glass jar with metal foil on the bottom and two-thirds of the way up on the inner and outer surfaces. Modern capacitors are more advanced but still use the same principle: separating two conducting materials with an insulating material such as glass, oil, plastic, etc. The insulating material must be thin and have good dielectric strength. The thinner the insulating material can be without breaking down, the greater the capacitance.

Testing was accomplished by building a Tesla Coil which required a variable capacitor bank. A suitable bank of high voltage, rapid charge/discharge capacitors were made using wine bottles, spray adhesive, aluminum foil, table salt, water, insulating foam, and a five gallon plastic bucket. The capacitance was varied by changing the number of capacitors joined in parallel. Very fine capacitance changes were made by adding or subtracting a conductive salt solution which was used as the interior conductive coating of the Leyden jar. The capacitors dielectrics were under intense stress during the operation of the coil.

Tesla Coil energy, being of interest, was also investigated. The investigation involved the ionization of low pressure gases using high energy radio waves, the photographic study of plasma discharge shape variation due to terminal shape, and the interaction between high voltage and insulating materials.

#Honorable Mention - Eastman Kodak Company

TEST STAND DESIGNING, BUILDING & OPERATING

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PROBLEMS: 1. Design a dynamometer stand that could take the force produced by an engine under full power.
2. Rebuild an engine and test the engine under controlled conditions.
HYPOTHESIS: Draw possible designs until one is found that is strong, adaptable to different engines, and practical. Research the rebuilding of engines, horsepower, and torque ratings of the engine to be tested.
METHODS: The dynamometer stand parts were cut, squared, checked for twists, welded together, and painted. The engine was dismantled, cleaned, inspected and new parts were installed. Upon completion of the engine it was installed on the dynamometer stand for testing.
RESULTS: After starting the engine it was adjusted to specifications and the engine was run on the dynamometer stand with test results being recorded and compared to factory specifications.
CONCLUSIONS: The recorded results were not comparable to the factory specifications because there was an increase of 12 cubic inches to the displacement, a new non factory cam was installed, a different carburetor was used, and the engine was tested at a lower RPM. The engine performed beyond my expectations with good low end torque and power. The dynamometer stand withstood full power and I could not find any signs of cracks or stress to the stand.

COMPUTER AIDED ARCHITECTURAL ENGINEERING

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The purpose of this project was to increase efficiency of architectural engineering calculations by utilizing the microcomputer.

It was thought that using the microcomputer could greatly reduce the required time necessary to do architectural engineering design calculations and also be used to determine the material requirements for all types of structures.

The Apple IIe microcomputer with Apple works program was used with two sample sets of house plans. Using the microcomputer with the template program saves an average of two to three hours over using the calculator or doing the calculations by hand.

The microcomputer proved to be a very useful, time saving tool for architectural engineering requirements. The use of the computer is very practical for small building additions or large structural complexes. The program also leaves less chance for calculation errors by eliminating hand calculations.

INCREASING AN AIRCRAFT'S STALL ANGLE WITH DESIGN MODIFICATIONS

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SUMMARY: On the last days of August, 1987, a Northwest Airlines MD-82 crashed after departing Detroit Met. Airport. The accepted reason for this crash was an eventual stall that resulted from an incorrect flap and slat setting during take off. Stall characteristics could be changed greatly and occur at lower speeds with the modifications of the aircraft's wings.
EXPERIMENT: A wind tunnel was built in order to test and record the stall angles of two wings, the first was conventional while the second consisted of a series of slots. The angle needed to stall both airfoils was recorded.
OBSERVATIONS: The wing with three progressive slots stalled at a higher angle of attack thereby being more difficult to stall.
CONCLUSIONS: A conventional 747 stalls at a speed of 130 miles per hour. If using the system of wings with progressive slots, it would stall at 150 miles per hour. A difference in 20 miles per hour in stall speed is achieved by using the three progressive slots.

A MODEL OF A LOCK AND DAM

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The main purpose of my project is to find out if any lock and dam can allow the weight of any vessel to pass through the lock without resistance. This in turn will be helpful in the designing of other locks and dams.

As a hypothesis, I stated that a lock and dam is capable of allowing a heavy vessel to pass through without resistance from the lock. The procedure concerning the project consists of the designing, constructing, and the actual operation of the model.

The results show that a lock and dam is capable of allowing a navigating vessel to pass through without resistance. The size of the vessel depends on the size of the lock.

Upon the completion of my research and study, I have found my hypothesis to be correct and accurate with the theories of hydraulic engineers. I have learned much from this investigation and hope to learn more about river navigation.

FRED: A HOMEMADE SINGLE-BOARD COMPUTER/CONTROLLER APPLICATION

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FRED is an application of a single-board computer and device controller of my own design and construction. My engineering goals are summed up in the phrase, "high versatility in a small package at a low cost." I constructed the 11 x 15 cm wire-wrapped prototype board over a period of seven months at an approximate cost of $60.00. I drew the schematic diagrams with a graphics program on my Atari ST personal computer. The design is based on the Z8 microprocessor family and features 2K of system ROM, 2K of user RAM, BASIC interpreter, built-in audio amplifier and speaker, allophone speech synthesizer, three high-current digital outputs, three digital inputs, and a high-power relay driver for two reversible DC motors. Its versatile 110 - 19,200 baud RS232 serial interface port allows it to communicate with virtually any terminal or personal computer. Computer/controller technology has thousands of uses, but cost and time considerations prompted me to select an experimental application. My board is used to control a "freely roving electronic device," or FRED. It can move under program control, detect obstacles, speak, and blink its "eyes." It uses its serial port to receive BASIC programs from my Atari, then operates autonomously without external connections or radio control.

#Fourth Award - ISEF/Engineering
Honorable Mention - National Aeronautics and Space Administration

THE DEVELOPMENT AND TESTING OF A TUBULAR SOLAR AIR HEATER

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Solar collection devices have been in use for many years. Most solar designs are basically five-walled boxes that absorb shortwave radiation and give off longwave radiation which is usually trapped as heat in the "green-house" effect. Most of these designs are used to heat water.

The purpose of this project is to develop a solar collecting air heater which uses vertical tubing to increase the surface area for solar collection and direct heat transfer to the air flowing through the tubes. Several types of tubing configurations were tried experimentally until one design was found to best absorb and conduct radiant energy most efficiently.

Two different variations of the design were developed:1) a vertical tubular configuration only and 2) a vertical tubular configuration with black epoxied quartz crystals for additional energy storage. A third device without the internal tubes was built for a scientific control. Air was forced through the tubes by identical air flow systems. Both intake and output air temperatures were monitored.

Tests were monitored with a computer and an interface that uses thermistors to measure the temperatures of the intake and output air. In all trials, the collector with the tubing provided more heat than the control and became even more efficient when used in conjunction with the special heat sink material.

With this project I was able to design a solar heater that uses all three forms of heat transfer: radiation, conduction, and convection to transform the sun's light waves into heat energy. This device is much more size efficient than contemporary systems.

#First Award - Midwest Research Institute, through its division, the Solar Energy Research Institute
First Award - U.S. Department of Energy

ROTATABLE WINGS - PROPELLER DYNAMICS PHASE II

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All of the current vertical take off and landing (VTOL) aircraft concepts are compromise designs in either the VTOL or forward flight mode. A new aircraft design concept was developed as a science project which provides the vertical lift capability of a rotary wing (helicopter) with the forward flight capability of a fixed wing aircraft. This is accomplished by making the wing rotatable under power, and adjusting the incidence angles of the right wing with respect to the left wing, like a propeller, for the VTOL mode. After reaching sufficient forward velocity, rotation of the wing is stopped, all power is transferred to the thrust system, and the aircraft is configured, and performs as a conventional fixed wing aircraft. This project was developed as two projects in one. The first project developed the rotatable wing concept as it could be applied to full scale aircraft, and developed applications for the design that could only be fully advantageous through the capabilities of the rotatable wing concept. The second project designed and developed a working simulator to demonstrate the concept. The simulator has twelve working functions. It used two radio control transmitters, three receivers, thirteen servos, two samarium cobalt permanent magnet motors, two electronic speed controls, six power supplies, one battery pack, and two battery chargers. Many special purpose parts were designed and built. Thirty eight ball bearings were installed in the special parts that were developed. Fiberglass shells were built to form the fuselage and wing/rotor hub.

#Second Award - U.S. Air Force
Third Award - International Aerospace Hall of Fame
Fourth Award - ISEF/Engineering
Honorable Mention - National Aeronautics and Space Administration

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THE EFFECTS OF CROSSWINDS ON VEHICULAR MOTION STAGE II

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This study used a standard roadway, a standard car frame, and a single set of axles and wheels. The single variable was the aerodynamic design of the vehicles being tested. They were constructed to a 1/29 scale, and tested at a scale speed of 55 m.p.h. The wind was constant from a fan, and simulated a 52.2 m.p.h. wind. The models travelled down the standard roadway, and 40 measurements were taken showing how much each model turned from 0 degrees.

The models of mini-vans from Ford and Chrysler corporations were MORE stable in crosswinds than their previous models. However, the model of the light weight Chevrolet Astro van was deflected to a distance considered dangerous by experts. Utility vehicles and related pickup truck models were deflected equally, and were generally deflected less than vans.

Officials at the National Highway Traffic Safety Administration followed up with a computer study of fatal accidents. They discovered that my crosswind susceptability findings correlated in every case with accident rates. The possibility of that happening by chance is a mere 1 in 1,048,576. It is very likely that in larger vehicles crosswinds often make the difference between a close call and an accident.

LOW DRAG TURBOSAIL DESIGN: A TWO YEAR STUDY

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In this project, I have continued the study of turbosail design, which I began in my science project last year. A turbosail is an experimental propulsion device for ships. It consists of a vertical, hollow tube with a narrow slot running its length, and a fan mounted at the top. When a symmetrical sail is placed in a wind stream, and the fan at the top of the sail draws air into the tube through the slot the velocity of the air on that side of the sail increases. This increased air velocity creates low pressure. Higher pressure on the opposite side of the sail creates lift in the direction of the low pressure.

This year I have designed and built two totally new, low drag turbosails, as well as a scaled-down model of the best turbosail design from last year's project. Both new designs were based on a standard symmetrical airfoil shape. On one low drag turbosail I used a single 1/4 inch wide slot, and on the other, I used two parallel 1/8 inch slots.

I tested each of the sails in a laboratory wind tunnel, and measured the amount of lift and drag that each turbosail produced at three wind speeds. I compared these results to the amount of lift and drag produced by the best turbosail design from last year's project. I measured static pressure differences around each of the sails to support the lift and drag measurements. I found that my low drag turbosails produced more lift and considerably less drag than the nearly cylindrical turbosail.

#Scholarship - U.S. Navy
Third Award - Ball Corporation
Third Award - ISEF/Engineering

WAVEFORM SYNTHESIS

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In the field of power electronics, sinusoidal waveforms of variable frequency are required at multi-kilowatt power levels for the operation of large electrical machinery. In this power range, standard amplification schemes are too inefficient, and "on-off" switching devices must be used. Sinusoidal waveforms are generated by switching a source of direct or alternating current at high frequencies and then low pass filtering to synthesize the desired waveforms. Switching frequencies which are much higher than the those of the desired waveform are used.

Computer modelling studies at a circuit functional level were conducted for the hysteresis comparator, pulse width modulator, and a modified delta modulator. The modified delta modulator configured to switch packets of high frequencies at times of zero voltage has exciting promise in extending the power range of available power semiconductors. Parameters which improve the fidelity of the synthesized waveform were identified.

The circuits were constructed and their performance was compared with the modelling results. Detailed simulation and experimental results are presented which define the range of switching frequencies required to synthesize waveforms of low harmonic content.

#Second Award - ISEF/Engineering
Third Award - Institute of Electrical and Electronics Engineers

INVESTIGATION OF THE LATTICEWORK OF A SUPERCONDUCTOR THROUGH X-RAY DIFFRACTION

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This project investigates the structure and lattice work of a superconductor through X-ray diffraction using the structure of silicon as a semiconductor for reference. The accepted theory behind the niobium-compound low-temperature superconductors and the proposed theories behind the new rare-earth-element based high-temperature superconductors are presented in the theory section. This student made the superconductive compound yttrium-barium-copper-oxide and tested its resistance using facilities at the University of Alabama at Huntsville under the instruction of Dr. M. K. Wu. There an initial X-ray diffraction test was made. Further tests were made at Auburn University under the instruction of Dr. Ralph H. Zee, using newer X-ray facilities. X-ray diffraction tests were run first on powdered silicon, the control in the experiment used to familiarize this student with calculations from X-ray diffraction. This student scanned yttrium-barium-copper-oxide and then made comparisons to theoretical calculations made with data obtained from Japanese research. This experiment not only verifies the structure of $Y Ba_2Cu_3O_{7-x}$, but also gives clues to the undiscovered mechanism governing the new high-temperature superconductors.

#Scholarship - The University of Alabama in Huntsville
Second Award - ISEF/Engineering

AN INVESTIGATION INTO THE TECHNIQUES USED IN MODERN BRIDGE BUILDING

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This project is a comparative analysis of several different truss bridge designs. The project consists of background research, construction of bridges and the testing apparatus, actual testing and observation of bridge performance, and analysis of results.

Generally, heavier, more elaborate bridges will provide greater support and withstand larger loads. However, a primary objective was to compare bridges of equal spans with different designs and thus, different masses. Subsequently, an efficiency ratio, a ratio of the mass of the structure to the maximum load supported by the bridge, was devised. Also, because a comparison of the rigidity of the designs was desired, a strain gauge was designed to measure the vertical deflection of each structure.

Experimentation has shown that heavier designs are stronger, in general, and lighter designs are generally more efficient. Reinforcing a light design will create a stronger, more rigid structure, but it will also compromise the efficiency of the bridge. This combination is often a desirable compromise, such as in the simple Pratt and Warren trusses tested, which combined the better aspects of a heavy, strong design and a light, efficient design. Results also dictate that in the use of balsa or other materials possessing a high compressive strength, a deck bridge is, in some respects, superior. The best design for any situation depends upon many factors, such as local soil character, weather conditions and other environmental conditions, the length of span required, anticipated bridge loads, possible water traffic, properties of building materials, and any other factors associated with a given situation.

#Second Award - American Society of Civil Engineers

THE VIABLE FUNCTIONS OF THE COAL-BURNING FACTORY WASTE - FLY ASH

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Everyone knows that pollution is a growing problem and any way to use these pollutants without disposal relieves a tremendous strain on the environment. Fly ash, a waste product of coal-burning electrical plants composed mainly of silicon oxide, aluminum oxide, calcium oxide and sulphur trioxide, is one of the major by-products of the energy producing industry. My studies are an attempt to find a beneficial process of relieving this strain on the environment. In order to do this, I made cementitious blocks similar to those used in housing construction replacing the cement with fly ash. The blocks were tested for compression strength, set-up time and weathering. I found beneficial uses in the construction of highways as well. Experimentation using the material in different sections of the highway resulted in a reduction of water permeability without a loss of durability. The ash also has uses in the production of a lightweight, porous foam. This material produced from fly ash, sodium silicate and fiberglass resin, could be shaped before being heated to produce a sheet usable for housing insulation.

HOW DO DIFFERENT WINGTIP DEVICES AFFECT THE LIFT, DRAG, AND PITCHING MOMENT OF AN AIRPLANE?

Day, Steven T., Dayton Christian High School, Dayton, OH 45405
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In this project, a study of how various modifications to the wing of an airplane affected the performance of the airplane was made. Four unique wing modifications were designed. Three were tested on monoplanes and the fourth was tested on a biplane. These modifications are needed because of a force on an airplane called induced drag. This type of drag produces a spinning of air called a vortex at the tip of the wings. Each modification was designed to block the vortex after it formed, or to prevent it from forming in the first place. Each modification was tested to see how the lift, drag, pitching moment (pm) and lift to drag ratio (l/d) was affected. These modifications were tested five times each to ensure accuracy. After the experimentation was completed, conclusions were made as to how well the modification worked and how well they improved the airplane's efficiency. Applications were also made as to how these modifications could be used in the real world.

MINIMIZING THE AIDS RISK: A PHYSICS APPROACH

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Information about the elastic properties and strength characteristics of a material is necessary to design a structure and the dimensions of that structure which are capable of withstanding the various loading conditions in service.

This study involves the construction and calibration of a linear variable differential force transducer and a diffraction strain gauge for experiments with an elastomeric material to determine causes of breakage and the characteristics which attribute to greater elasticity. This study demonstrates the use of calculated stress, strain, tensile strength, elongation, Poisson Ratios, and Young's modulus to determine these factors.

In conclusion, it explicates the effects of: a talc used by manufacturers in the packaging process, non-petroleum based lubricants, and other stimuli. It also shows the differences of elasticity and strength between types and brands and proposes the most endurate types and structures.

ENVIRONMENTAL SCIENCES

* SODIUM TETRAPHENYLBORON: A TOXICITY BIOASSAY ON FRESHWATER ORGANISMS

Gardo, Jessica, Hilton Head High School, Hilton Head Island, S.C. 29928
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Sodium tetraphenylboron (NaTPB) is a substance used to precipitate the radioisotope Cesium-137 from toxic nuclear waste through a process called glassification. This procedure is used to solidify radioactive waste for encasement and long term burial.During glassification NaTPB becomes a supernatant;and as such, its toxicity is an important environmental concern. Although NaTPB's chemical properties and effects on anaerobic microbial flora have been tested, its toxicity to freshwater organisms remains uncertain. The purpose of this project was to assess the LC50 of NaTPB and its byproduct, diphenyl boric acid (DPBA) on Daphnia, an invertebrate crustacean.

A series of 24-hour range and 48-hour definitive static toxicity tests were conducted over a 45 day period in a classroom laboratory. Using statistical analysis of the quantal results, the chemical concentrations were determined toxic at .36mg/L for NaTPB and at 1.95 mg/L for DPBA. These LC50 calculations demonstrate the lethal capacity of both compounds at minimal concentrations. These results may significantly impact future use and disposal of NaTPB within the glassification process.

*Second Award - U.S. Air Force

THE EFFECTS OF C. PENNSYLVANICUS ON THE ACID CONTENT OF SOIL

Gary Salman
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The purpose of my project is to demonstrate that the production of formic acid by certain ants can contribute to the formic acid content in the environment. I demonstrated that Camponotus pennsylvanicus produced formic acid and that they distributed it into the soil that they lived in.

In a natural setting formic acid might leach out of the soil into nearby streams and lakes and then contaminate them. This contamination might cause the pH of the lakes and streams to drop, and cause similiar damage caused by man made pollutants such as nitric and sulfuric acids.

I allowed the ants to live in a colony for a 9 week period. I checked the pH weekly to test if the ants produced any acid, therefore causing the pH to lower. After 5 and 9 weeks I performed an ammoniacal silver hydroxide test which tested for the presence of formic acid. The soil tested positive for formic acid. I also followed the same procedure for a colony of Harvester Ants. I tested the soil before the ants were put in, and 5 and 9 weeks after the ants were put. There was no appreciable pH change or evidence of formic acid.

WHAT IS THE HARDNESS OF TAP WATER?

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Hardness is the standard term used to describe the levels of calcium and magnesium metal ions in tap water supplies. This project was designed in order to measure the levels of tap water hardness throughout the Southern California region, and to promote public awareness of the causes and effects of hard water use.

Water samples were collected from eight areas, varying in distance around Southern California. Throughout various methods such as complexion with soap, the use of a conductivity apparatus subjective taste and sight analysis, I hypothesized that the water from LaCanada would have the highest levels of hardness while the water from Simi Valley would be the softest. The procedure followed was titration with the disodium salt of the ligand Ethylenediaminetetraacetic Acid, also known as EDTA. The levels of hardness were determined, and compared to the accepted values furnished by the Department of Water and Power and the Metropolitan Water District.

The supply lines of tap water were mapped out to their respective sources. (These are four major areas of water organization.) It was discovered that there is a direct relationship between the supply line and the hardness of public tap water. It is distinct to the degree that one can trace the source of one's tap water solely by its hardness content. The options and possible solutions to hard water supply are explored and explained.

PHYTOTOXICITY, DEGRADATION, VOLATILITY AND THEIR POTENTIAL INFLUENCE ON EPA CLASSIFICATION

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When considering toxicant pollution, three phases must be taken into account. The first of these phases is phytotoxicity. In this phase, the selectivity of the pesticide should determine the risk factor. The second phase is degradation. Phase two links the toxicity of the individual pesticide and the rate of breakdown. The third and final phase is volatility. This phase is independent from all other factors. It is important to consider these phases individually because the risk factor will vary for each one.

The Environmental Protection Agency has not looked at these factors individually, and because of this they have made an inconsistent rating system. These three phases effect the environment in different ways and for this reason cannot be grouped into one rating. The effects on humans is important but not always the best rating system.

#Fourth Award - ISEF/Environmental Sciences

IS LIMONENE AN EFFECTIVE PESTICIDE/HERBICIDE? A FIVE YEAR STUDY

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The purpose of this five year study was to determine if Limonene could be used as a natural Bio-Degradable Pesticide/Herbicide. Limonene was extracted from peelings of grapefruit, oranges and lemons and also used in the laboratory form in these experiments.

PHASE I: Wild type Drosophila melanogaster were maintained and observed in vials containing fruit fly media and lemon, orange and grapefruit extract. Wild type fruit flies were tested in 100% extract.

PHASE II: Wild type,White eye,Vestigial and Ebony strains of Drosophila melanogaster were maintained and observed in Fruit fly media and lemon, orange andgrapefruit extracts. The extract concentrations of 25%, 50%, 75%, and 100% were mixed with the fruit fly media, few numbers of living Larvae, Pupae and Adult flies were counted in both Phase I & II.

PHASE III: Citrus peeling extracts were injected into a Gas Chromotography Unit and collected in a vial. The collected compounds were analyzed in an Infrared Spectroscopy Unit. Limonene was identified as one of the compounds in all three extracts.

PHASE IV: A Klett reading and viability test was used with various concentrations of Limonene. It was found that E. coli and S. epidermidis do tolerate Limonene.

PHASE V: Limonene was used as a selective Herbicide with noxious weeds. Black night shade, Buttonweed, Thistle, Wild Strawberry, Smartweed, Milkweed and Pigweed were sprayed with concentrations of 10,20,30,40,50,60,70, 80,90 and 100% Limonene. The results of this experiment indicate that Limonene can be used as an effective selective Bio-Degradable Pesticide/ Herbicide.

#Third Award - ISEF/Environmental Sciences

SALINITY OF THE SOILS AROUND THE GREAT SALT LAKE

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There has been a great deal of concern over the damage that has occurred from the Great Salt Lake rising and inundating wildlife and agricultural area.

I began this project with the goal in mind of further understanding the lake and the effects of the sal water of the lake on the surrounding shore areas.

First of all, I devised a sampling technique which I used to extract 2000 gram portions of soil from several sites around the lake. At least four samples were taken from every site. The samples were then taken back to the laboratory and dried out for accurate mass measuring.

Through a process of leaching, I could calculate the amount of salt in the different soil samples. The first sample at every site was taken just below the water level and the next three an average distance apart up to and above the high water mark(a 120 year high piontfor the lake). Sites were selected on the basis of how well they represented the general area. Samples were taken from areas of different soil types for a better understanding of salt retension in the soils.

The measurments that I have made can be used in further studies of the effects of salinity on the habitat. These measurements are preliminary figures that can be used also to determine changes in the salinity over time.

THE IMPACT OF INTERNAL PHOSPHORUS LOADING ON THE RESTORATION OF TROUT LAKE

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Trout Lake near Coleraine, MN, is a deep lake which has experienced a decline in water quality due to inflow of effluents from a sewage treatment plant. Sewage diversion took place in 1987; however, since lake restoration can be delayed by internal phosphorus release from the sediments, it was important to consider the impact of this problem. The primary objective of this study was to develop a model that predicts a total phosphorus concentration by accounting for internal loading. Laboratory experiments were conducted to develop a method of measuring changes in release rates without intensive field sampling. Restoration techniques were also evaluated. Trout Lake was monitored from April to October, 1987 for temperature, dissolved oxygen, transparency, and total phosphorus. These values were used with Carlson's Index to evaluate current trophic status and to quantify internal phosphorus loading. Experiments were conducted with a novel method of creating anoxic conditions and laboratory phosphorus release rates were correlated with lake observations. A summer average of 0.050 mg/l phosphorus indicated the lake to be eutrophic (TSI=60). Sewage diversion reduced the annual load of phosphorus by 70%. Internal loading to the lake was found to be 0.542 $g/m^2/yr$, giving an internal release rate over the 105 day anoxic period of 10.6 $mg/m^2/day$. A model, $(P_e) = (L_{ext} + L_{int})/13.7\ q_s$, was developed to assess the impact of restoration efforts. Finally, the results of laboratory work indicate that changes in release rates can be monitored using the procedure developed.

#First Award - Bureau of Reclamation/U.S. Department of the Interior
Third Award - ISEF/Environmental Sciences
First Alternate to Scholarship - The Ohio State University

CHEMICAL COCKTAILS

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This experiment was conducted by testing well water Northeast of Cheyenne, WY. The purpose of this experiment was to see if there is a correlation between animal population and well water contamination by Fecal Coliform. The well water was tested for not only Fecal Coliform but also pH, Conductivity, and Total Dissolvability of Solids (T.D.S.). Twenty wells were randomly selected and tested. A questionnaire about the surrounding area and well was completed by each home owner. The results that were derived from this experiment were that there was no presence of Fecal Coliform. The other areas tested were the following in averages. pH has an average of 7.210, Conductivity, -0.065, and T.D.S., -0.044. Other things taken into consideration were number of Animals, Distance of closest animals, Well Depth, and Age of Well. From these studies and experiments, the conclusions that were obtained were that the wells tested Northeast of Cheyenne are free from fecal contamination. This can possibly be due to two facts. The first being the wells are deep enough that aquifers filter out any contamination. The second being because of an increase of wells in that section of town. Because of the increase the water tables are falling and the water passes through more layers of rock and aquifer which purifies the water.

THE EFFECT OF AN AERATED SUB-IRRIGATION SYSTEM ON CROP PRODUCTION AND SOIL SURFACE HORISON EROSION

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This study was concerned with the effects of a ventilated sub-irrigation system on crop production and soil surface horizon erosion under environmental conditions. The researcher selected the three major spring planting crops - yellow silage corn, hybrid variety SX-352, grain sorgum, hybrid variety Williams-82, and soybeans, hybrid variety WAC-710-DR. While the ventilated sub-irrigation system was installed below ground in the experimental plot, an above ground sprinkling system was set-up on the control plot. Each plot received an equal amount of water through irrigation, though the experimental group was constantly ventilated when no irrigating was taking place. The experiment was conducted for a total of 175 days. The growth rate, stem circumference, dry root weight, and crop yields for each crop were measured and recorded. The effect of air ventilation on soil surface horizon erosion was also measured at the conclusion of the experiment. It was found that the experimental grew taller, and had a larger stem circumference than that of the control group. The dry root weight of the experimental group was slightly higher than that of the control group, and, on the average, the experimental group had a significantly higher crop yield than that of the control group. As for soil erosion, it was found that the control plot experienced five times the degree of ero sion as that of the experimental plot. A statistical analysis test, the Mann Whitney U, was performed and it was found that all data was significant at the 0.05 level. From the data collected, it was concluded that ventilating the plant root zone by means of an aerated sub-irrigation does, in fact, significantly effect the amount of soil eroded on a plot, as well as the overall crop production of the plot.

#Third Award - Bureau of Reclamation/U.S. Department of the Interior

NITRATE FILTRATION WITH TRICKLING SYSTEMS

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Finding a solution to decrease the amount of nitrates is our water may begin with filtering the nitrates from field tile runoffs. Research was conducted to investigate various readily available substances which would attract the nitrates in the water. By building filters made of inverted two liter pop bottles and filling them with various substances which seemed to have an affinity for nitrates. Water with notable contamination was poured through and then tested. Filter one consisted of activated charcoal with zeolite ammonia remover and sodium chloride. In filter two finely crushed gravel was added to slow down the rate of the water flow. Filter three contained pelletized alfalfa, and fiter four had activated charcoal in it. Filters one and two attracted nitrates but the post filtered water contained a salinity level that would be unacceptable. Filter substances of activated charcoal and zeolite ammonia remover are relatively expensive when compared to the sodium chloride and pelletized alfalfa. In an experimental run using water of 30 ppm (parts per million), the filtered water contained approximately 8 ppm after going through the filter made of pelletized alfalfa. So therefore, pelletized alfalfa being 100% natural, cost efficient, and having the most affinity for nitrates is the best filter for trickling water systems of the materials used here.

*LANDFILL LOTTERY: EFFECTS OF COMMON LIQUIDS ON CLAY LINERS

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There are hundreds of thousands of landfills in the United States which contain assorted industrial and household wastes. A liner of low permeability, usually compacted clay, is used in the bottom of these landfills. Rainwater soaking into the decomposing garbage forms a polluted mixture of water and hazardous solutes called leachate. If this leachate enters the groundwater system, on which 80 percent of municipal water systems rely, serious health hazards can occur. The purpose of this project was to determine whether compacted clay liners provide an effective barrier to common liquids.

The liquids chosen for this experiment were ones whicn may be disposed of in landfills: ammonia, motor oil, gasoline, drain opener/cleaner, muriatic acid, vinegar, paint thinner, detergent, bleach, and distilled water (the control). Tests were conducted in test units containing compacted clay in a pipe segment. Two test units were filled with a fixed volume of each of the ten test liquids. Twice a day, measurements were taken of how much the liquid volume decreased in relation to the original volume.

The results of this experiment show that many common liquids not only can penetrate clay liners, but also have a significant effect on the clay itself. The caustic materials, most of which caused the clay to expand, passed through the clay liner in only a few days. The petroleum products caused the clay to compact and took a few days longer to soak through the compacted clay. All but one of the remaining liquids also penetrated the test clay liners, but at a much slower rate. These results make clear the need for immediate attention to the problem of leachate control in landfills.

***Fourth Award - ISEF/Environmental Sciences**

* HOW DO DETERGENTS AFFECT PHYTOPLANKTON COMMUNITIES?

Foster, Dehron L., South Terrebonne H.S., Bourg, LA 70343
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Problem: How do detergents affect phytoplankton communities and the marine environment?

Hypothesis: Certain amounts of different detergents will cause either death or over-growth in phytoplankton communities, causing harm to the marine environment.

Procedure: Collect five gallons of bayou water and divide it into 58 different test tubes. Tide is added to 24 of them in 8 different concentrations, and Ivory Snow is added to 24 of them in 8 different concentrations.

Data: Each day for two weeks, data is collected. Samples are read using a fluorometer, and the measurements are recorded and averaged. The results are fed into a computer.

Results: The results show that, as stated in the hypothesis, over-growth or death has occurred in several of the groups.

Conclusions; If the amount of detergent allowed to enter into the marine environment is regulated, death or over-growth of phytoplankton because of detergents can be controlled.

Applications: The results of this experiment can be helpful in controlling pollution of the marine environment due to washing detergents.

***Scholarship - The Ohio State University**

IS THE WITHLACOOCHEE RIVER DRAINING THE FLORIDAN AQUIFER?

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The purpose of this project is to determine if the Withlacoochee River is interconnected with underlying water bearing formations. Null Hypothesis (H0): The Withlacoochee River is not draining the Floridan Aquifer. Alternative Hypothesis (Ha): The Withlacoochee River is draining the Floridan Aquifer.

My experimentation region covered two thousand two hundred (2,200) square miles and extended one hundred fifty-seven (157) miles from the headwaters of the Withlacoochee River in Green Swamp to the Withlacoochee River at Inglis. I also took measurements on the Little Withlacoochee River, Jumper Creek and Clay Sink. At each site I measured specific conductance and temperature, using a YSI 3000 Temperature, Level and Conductance (TLC) Meter. The control consisted of readings of specific conductance of water pumped from wells along the Withlacoochee River. I compared surface-water measurements to these well readings.

Through testing, I have determined that the Withlacoochee River is totally spring fed. My project then developed into a test to find the intensity of the interconnection of the Withlacoochee River and the Floridan Aquifer. This was accomplished using water-quality, water-level and stream-discharge data within the Withlacoochee River Basin. I drew conclusions using water-quality data provided by the United States Geological Survey.

I concluded that the Withlacoochee River is well-connected to and is draining the Floridan Aquifer. In the Green Swamp water is flowing from high ground (100 ft. above sea level) to the decreasing altitude at Inglis (10 ft. above sea level). In the Green Swamp the flow path of water feeding into the Withlacoochee River is shorter than that at any other part of the river. This produces water that is barely mineralized. Other parts of the river are fed by longer flow paths, therefore, a greater length of time is allowed for minerals from lime-stone in the Floridan Aquifer to dissolve in the water. This causes more mineralized water in the downstream reach of the river.

I fail to accept the null hypothesis and currently accept the alternative hypothesis with high significance.

#First Award - American Geological Institute
Third Award - American Water Works Association
Fourth Award - ISEF/Environmental Sciences

ANALYSIS OF THE INSECTICIDAL PROPERTIES OF CITRUS PEEL OIL

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Synthetic insecticides present a serious threat to the environment, and viable organic alternatives to these substances must be found. Citrus peel oil may be one such alternative.

The purpose of my research is to determine the insecticidal effect the ethereal oils of citrus have on Acheta domestica, and to identify the insecticidal compound in the peel oil.

Grapefruit, orange, lemon, and lime were used in the procedure. Sixty grams of the peel flavedo were grated and placed in a three liter cylinder under a wire mesh. Ten crickets were placed on top of the screen, and the cylinder was sealed. Data was collected as to cricket fatalities. Three trials were done for each fruit.

Cricket deaths were graphed in average fatality periods. The concentrations of the principal constituents of the peel oil were also graphed. The graphs were then compared. There was a direct, proportional correlation between the average number of fatalities at a median time and the concentration of the compound d-limonene. Ten crickets were then exposed to one ml of the isolated d-limonene compound, with fatalities resulting.

The conclusion was reached that d-limonene is the insecticidal compound in the citrus peel oil and that it may be used as an organic insecticide against Acheta domestica.

#Second Award - ISEF/Environmental Sciences

THE FINAL STUDY-PERCA P. FLAVESCENS VS. CAMBARUS C. VIRILIS-A FOUR YEAR STUDY OF THE INTAKE OF RADIOACTIVE ISOTOPES

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Paulina, LA 70763

The purpose of my project is to expose fish and crawfish to 32P,125I, 137Cs, and 89Sr. To compare beta and gamma and cation and anion intake and distribution to various organs of each specie.
The procedure involves placing 20 fish and 20 crawfish in 8 aquariums;5 in each;each tank containing a solution of 10 microcuries to 3 liters of water.(experimentation) Use 1 control of each specie for each experiment. Allow species to absorb radiation for 3 days and dissect.
125I and 89Sr (gamma rays) assimilated the most radiation. Radioactive counts were 2-3 times higher for cations(137Cs and 89Sr) than anions. The crawfish assimilated more radiation than the fish. The organs that assimilated the most radiation were the intestines and gills. The muscle assimilated the least radiation.
My conclusion can be explained due to the natural filtering process that occurs in the organs of each specie. Also my conclusion can be explained due to the metabolism of each specie. The most important explanation is due to an enzymatic reaction which takes place in each organ listed. (Substrate and enzyme must connect for radiation to be excreted from species).

HIGH DENSITY PINE PLANTING FOR BIOMASS ENERGY

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Marianna High School, Marianna, Florida 32446
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The purpose of this project is to determine the actual "Biomass Energy" at the end of the six year period. The pines were planted at the rate of 6,000 trees per acre for a high density planting. Normal pine planting is 800 to 1,000 trees per acre.

The results of this investigation summarizes the growth gain and survival rate after a first, second, third, fourth, and fifth year period. At the end of the sixth and final year I determined the actual "Biomass" on each of the two sites.

Sites selected were flatland, high sandy ridge, and lowland. The lowland site was accidently burned in 1984.

At the end of the sixth year I found that High Density Planting can be used as an alternative form of energy. The net value per acre per year was an excess of 500 dollars.

A STUDY OF VARIATIONS IN CONCENTRATIONS OF SELECT TRANSITION METALS IN ANODONTA GRANDIS AND BENTHIC SEDIMENTS WITHIN A EUTROPHIC LAKE ENVIRONMENT

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The objective of this research is to determine whether or not a correlation exists between variations is concentrations of lead, zinc, and copper in benthic sediments and freshwater mussels within a eutrophic lake environment. This research was conducted in two parts. A controlled number of Anodonta grandis was placed at each of ten test sites and one control site. Gill tissue was removed, digested in nitric and perchloric acids, and analyzed by flameless atomic absorption spectrophotometry. Core samples of sediment were collected from each of the original test sites. These samples were dried, pulverized, and sifted through a #40 mesh seive. Three to five grams of <40 particles were digested in nitric acid and analyzed by the ion-coupled plasma technique. The variations in average concentrations of heavy metals in the freshwater mussels and sediment samples from respective test sites were compared. Statistical significance of this research was verified with the use of "Spearman's Rank Correlation" test. The results of this comparison indicate that there is no apparent correlation between the variations and, therefore, no accumulation of these heavy metals. The low concentrations and absence of a correlation between variations show no potential ecological hazard to the aquatic environment surrounding the "Viburnum Trend".

* PARAQUAT ELISA: QUANTIFICATION OF THE HERBICIDE PARAQUAT THROUGH THE USE OF SPECIFIC ANTIBODIES

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Purpose: To develop a new, sensitive method for the quantification of the herbicide paraquat; to use this method to quantitate paraquat in test samples; to compare this method to currently-available methods. Procedures: An "upside-down" enzyme-linked immunosorbent assay (ELISA) technique was developed and performed to establish the paraquat antibody titer of immunogenic rabbit blood sera. The paraquat antibody as well as an anti-rabbit IgG-peroxidase conjugate were used to develop an ELISA for paraquat. A standard curve of optical density against antigen concentration was then constructed and evaluated through multiple regression techniques. The standard curve was used to determine the percent recovery of paraquat in fortified samples of corn and soybean. The detection limit of the ELISA was also determined through the use of decreasing concentrations of paraquat in the ELISA. Results: Because of the low titer of paraquat antibodies in the antisera (as was indicated by the upside-down ELISA), relatively low serum dilutions ranging from 1:100 to 1:1000 were employed in the paraquat ELISA. An ELISA standard curve was then estimated; a multiple regression indicated that the optical densities of the estimated standard curve represent a fairly precise measure of antigen concentration. Results of statistical tests also suggested the paraquat ELISA to be a highly accurate means of quantifying paraquat in test samples; an average recovery of 100.2% with minimal variation was obtained. The ELISA was also quite sensitive, with a detection limit of 102 ng/ml. The ELISA appeared to possess significant advantages over methods currently available to detect paraquat. This research suggests the ELISA to be a promising method of paraquat quantification.

*First Award - ISEF/Environmental Sciences
First Award - U.S. Army

VIRAL CONTROL OF CITRUS RED MITES

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Today's Citrus Industry is in trouble due to red mites, *Panoychous citri.* These small arthropods feed on the leaves of citrus trees. This results in chlosis and defoliation of the leaves. These mites are usually controlled by pesticides. In this experiment the introduction of a noninclusive virus will be used in place of the pesticide for control of the mites.

Mites that were infected with this virus from California were ground up in a phosphate buffer with a Ph of 6.0. Then this homogenate was sprayed on eighteen citrus seedlings containing heavy populations of red mites. They were then monitored at intervals for infection. The virus is detected by viewing the mites on a glass slide through two polarized elements under a microscope. The virus particles in an infected red mite reflect the light and birefringent crystals are seen throughout the mite's body. In this experiment, the control plants were sprayed with water.

Successful introduction of a pathogenic citrus seedling in the greenhouse was a first step toward biological control rather than chemical control of this destructive pest.

A MULTI YEAR STUDY: THE EFFECTS ENVIRONMENTAL pH HAS ON CAMBARUS AND MUS MUSCULUS

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The purpose of this project was to determine if the extreme levels of pH, including acid rain, have detrimental effects on aquatic and terrestrial animals in our environment. The method of experimentation that I used required the observation of Mus musculus drinking alkaline water, acid rain, neutral water, and neutralized acid rain, and cambarus living in these same variations of water. With these organisms, I observed reproduction, social behavior, (territorialism, aggressiveness, retaliation, and passiveness), physical appearance, food consumption, water intake, weight, and length of the cambarus and Mus musculus in each level of pH.

The aquariums containing neutral water and neutralized acid rain produced the same beneficial results. This shows that the only variable being tested in this experiment to be acidity.

Each successive litter of cambarus and Mus musculus in alkaline and acidic water were smaller, thinner, and less active than both the control groups. The organisms in these groups lost weight and decreased activity, but food consumption and water intake was greatly increased. The aggressiveness of these groups decreased as territorial domination was lost. When Mus musculus were gradually brought back to a neutral pH, the deficiencies were greatly improved.

With hundreds of lakes already without fish, and natural buffers in forests greatly reduced, much damage has already been caused by acid precipitation. These tests show how imperative it is to find a cure for our escalating acid rain problem before the destruction of our environment becomes irreversible.

#First Award - ISEF/Environmental Sciences

INFRARED PHOTOGRAPHY: ANALYSIS AND USE IN AGRONOMICS

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The purpose of this project is to see if early plant stress can be detected through the use of infrared photography. My definition of plant stress is any abnormal condition to which the plants are subjected. A plan was devised to include testing, photographing, and analyzing a local winter wheat field. A tensiometer was borrowed from the Soil Conservation Service allowing me to monitor the amount of moisture in the root zone. On various days in December and January, infrared pictures were taken of the field and of a control group. Stress, by means of over and under watering and car exhaust pollution was induced on the control group. The progress of both the field and the control group was also noted through visible observation. I found the wheat fields to be fairly stable with only the slighest amount of stress shown. The infrared pictures were compared to river height, temperature, and precipitation; a relationship was found between stress and weather. The control group showed stress only in the polluted group. A significant amount of stress was evident in pictures taken only ten minutes after stressing for the first time. At the same time, nothing was visible as stress for another two weeks. Infrared photography does detect early plant stress before it is visible. This could help farmers reduce crop loss if used on a large scale; thus, increasing productivity which could lead to more efficient use of land, increased profits and lower prices for the consumer.

DETERMINING THE WATER QUALITY OF THE PRICE RIVER DRAINAGE

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The purpose of this project and study was to find the water quality of the Price River using a macroinvertebrate species diversity index. It was the first study of its kind known to be conducted on the Price River drainage.

Macroinvertebrates were collected with a Surber stream bottom sampler. They were counted and stored, then the results were put into tables and diversity calculated using the Patten equation for calculating diversity; which is $\bar{d}= -\sum(n1/n2)\ \mathrm{Log}_2\ (n1/n2)$.

It was found that the headwaters of the Price River do indeed have a high diversity, which indicates good water quality and that as one moves progressively downstream, the diversity does decrease, indicating poorer water quality. There was an exception, however, a small recovery zone in an area of the drainage that was expected to have a very low diversity value. The reason for this may be the slow moving water that extends upstream and allows the silt and suspended sediment to settle out.

The applications for the work done in this study are numerous. As stated before, it was the first known study of its kind done on the Price River. The river affects the lives of approximately 22,000 people. The information is useful to many government agencies, including the Price River Water Improvement District and also the Price regional office of the Utah Division of Wildlife Resources. A copy of a 20 - page report of this study was submitted to the UDWR and also to the Intermountain Junior Science and Humanities Symposium.

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* ZINC IN SEA URCHIN EMBRYOS

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Zinc contaminates oceans, streams and rivers. It causes damage to our plant and marine life. This project was designed to learn the amount of zinc that sea urchins absorbed during developmental stages. Using a spectrophotometer, dithizone, and known concentrations of zinc solutions, a standard graph of concentration vs. transmittance was prepared. The gametes were collected from sea urchins. The eggs were fertilized and placed into the zinc solutions at the different stages of development. One set of embryos was tested for zinc immediately after different stages of development. The other set was rinsed from the zinc environment and replaced into salt water. The second set was tested for zinc after the embryos had reached the gastrula stage. The results received were changed into concentrations by using the equation of the standard graph prepared earlier. The concentrations inside the embryo indicate that as the number of cells in the embryos increased so did the zinc concentration inside. This only occured upto the blastula stage. At this stage, the embryos did not take in any zinc. The second set of embryos indicate that there is some zinc lost when the embryos are placed back into normal environments as compared to the first set. Further investigations are necessary to prove hypotheses proposed for the absence of zinc absorption in the blastula stage.

*Third Award - ISEF/Environmental Sciences

INVESTIGATION OF CONTAMINANTS IN PAGO HARBOR, AMERICAN SAMOA.

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PURPOSE:To search for evidence of pollution in Pago Harbor, Am. Samoa.

Year one:Qualitative examination of fish livers showed those from industrial Pago Harbor were all unhealthy and those from nonindustrial Fagasa Bay were healthy.

Year two:I investigated heavy metal pollution in sediments and fish livers from Pago Harbor and Fagasa Bay. In the course of this investigation I found evidence, through qualitative analysis, of Mercury(Hg) and Lead(Pb) in sediments and fish livers collected from Pago Harbor. Samples from Fagasa Bay showed no evidence of Mercury or Lead.
Mercury and Lead are toxic substances and can greatly affect the health of a person who consumes fish that contain these metals. Mercury can be extremely poisonous if it accumulates in your body where it may affect mental coordination. Lead accumulation may damage the nervous system, kidneys, and it can affect red blood cells sometimes resulting in anemia. The source of Mercury in Pago Harbor may be from industrial wastes. Lead may be entering the harbor from the residues of old house paint, old paint cans discarded in the streams emptying into the harbor, discarded batteries, the oil dock, the power plant, or the marine railway.
If Mercury and Lead continue to accumulate in the food chains of organisms of Pago Harbor we end up with disastrous results. Therefore, I would recommend more extensive testing and research be carried out in order to learn exactly how serious this problem is and then to work out possible solutions to prevent this problem from escalating in the future.

EARTH SHELTERED HOMES: ENERGY EFFICIENCY OR HEALTH DEFICIENCY

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Previous testing proved earth sheltered homes to be more energy efficient than surface built homes. Therefore, earth sheltered homes should contain a higher level of radon gas contamination because of their high energy efficiency and proximity to the soil. The purpose of this project was to determine the levels of radon gas contamination in earth sheltered and surface built homes, and to prove that six radon reduction methods were effective in removing radon gas, which was represented by dry ice, from a model earth shelterd home. The radon contamination levels in the earth sheltered homes were: Number 241570 was 3.3 pCi/L, Number 517302 was 0.5 pCi/L, Number 517303 was 5.7 pCi/L, Number 517305 was 2.6 pCi/L. The radon contamination levels in the surface built homes were: Number 241571 was 0.4 pCi/L, Number 241572 was 1.8 pCi/L, Number 517301 was 1.6 pCi/L, Number 517304 was 3.0 pCi/L. The six radon reduction methods were: Natural Ventilation, Forced Ventilation, Sealing Cracks and Openings, Sub-Slab Suction, Prevention of House Depressurization, and House Pressurization. Each of these methods effecively removed radon gas, which was represented by dry ice vapor, from the model earth sheltered home. In summary, the earth sheltered homes contained higher levels of radon gas contamination than surface built homes. The radon reduction methods effectively removed the radon gas, which was represented by dry ice, from the model earth sheltered home.

FEASIBILITY OF ALGAE FOR PURIFYING INDUSTRIAL WASTE WATER

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615 Baker Street Wiggins, Mississippi 39577

The purpose of this study is to discover if common freshwater as well as four different types of marine algae can be used to purify industrial waste water.
To produce results, six different experiments were conducted in two phases. The same procedure was followed in each experiment. Phase I began when eight equal samples of a heterogeneous mixture of freshwater algae were added to four equal solutions of lead (II) nitrate and mercury (I) nitrate. When these solutions no longer showed the presence of lead or mercury ions, the second experiment was conducted using metal salt solutions at higher concentrations. It was discovered that lead (II) nitrate solutions at concentrations higher than the original were impossible to purify with the concentrations of freshwater and marine algae selected. However, the mercury (I) nitrate solutions were purified in all six experiments. The algae removed three different concentrations of mercury (I) nitrate from water--0.1, 0.2, and 0.3 parts per thousand--while it only removed the smallest of the lead concentrations tested--0.1 parts per thousand.

A TRASHY STUDY - THE DISTRIBUTION OF POLLUTION

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Opp High School, Opp, Al. 36467

This isthe second phase of a two year study of solid waste pollution. Two hundred meters of Highway 331 South and two hundred meters of Highway 331 North with a width of six meters from the pavement edge was staked off as the test areas. At given intervals for a three month period, all debris was picked up, counted, weighted, catagorized, and disposed of properly.
The study was designed to attempt to determine: How much litter was deposited on a major highway? What was the most common litter item? What kinds of materials were discarded? Is there any significant different in the litter appearing South of town as opposed to that North of town? Can the litter be identified as products of local establishments? What is being done to combat litter on Alabama highways? What measures are recommended to "Keep Alabama Beautiful"?

ARE CHLOROFLUOROCARBONS RESPONSIBLE FOR THE CATALYTIC DESTRUCTION OF OZONE?

Kevin Carlson
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This project deals with the catalytic reaction that involves a chlorine radical and ozone. This reaction takes place in the stratosphere, mainly over Antarctica. The chlorine radical is photochemically split from a chlorofluorocarbon, so it can be simulated in the lab. This is done with the use of a gas chromatograph. The instrument is used for detecting halocarbons, making it perfect for chlorofluorocarbons. The reaction was simulated by placing chlorofluorocarbon - 12 in a closed jar, and then inserting ozone into the jar. The chlorofluorocarbon-12 will be broken down by the electric arc in the ozone generator, simulating the ultraviolet light needed. The conclusions made were that chlorofluorocarbons do catalytically destroy ozone and that all the gases involved had certain retention times and characteristics that make them identifiable.

Acid Deposition, a three-year study

Shea Robinson
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My project began three years ago when I read a disturbing acticle on a mystery acid that was eating away at several historical sites. Since that time, my personal knowledge on the subject and the scientific community's knowledge has grown by leaps and bounds. Even though we have found effective ways of prevention, we hesitate to act while our earth is being destroyed little by little.

Timber (especially pine) is an economic necessity to my local community. Therefore, I decided to explore the controversial topic of the forest and its relationship to acid deposition.

In short, I exposed two species of nine to different pH levels. The results were startling; in only three months, I observed the decline and browning of lower pH's while the higher pH's thrived and grew at a rapid pace. With the slides I made from the trees, one can observe one less growth ring on the pH's of 4, 3, and 2 as compared to the control pH of 6.

It is clear to me; if results are observed in only three months, we are passing a death sentence upon our forests if we do not act NOW! We have reaped the benefits of a high-tech world, now comes "pay up" time. Do we shirk the responsibility and pass it on to our children, or do we face reality? Should we continue to ignore this problem, which can only get worse? Why not work together to preserve the world of today for the children of tomorrow?

EFFICIENT DISPOSAL OF WASTE OIL

McCarty, Valerie L.
Olmsted Falls High School
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Neighborhood gas stations must dispose of waste oil. There are disposal plants to accommodate this, but only at a cost to the gas station. If a gas station were to dispose of the waste oil itself, the process would have to be on a small scale with a low overhead cost. It ought to be environmentally sound, while also allowing for the chemical energy within the oil to be used.

Oil is combustible, but to obtain the goals described above it must be completely oxidized. An incomplete combustion is the result of insufficient Oxygen, and yields Carbon Monoxide and soot. The products of the desired complete combustion are Carbon Dioxide and water. This complete combustion can only be obtained with sufficient Oxygen, which is facilitated by vaporizing the oil before it is burned. To vaporize the oil from a liquid phase, it is made into a fine mist which evaporates. Although normally mists are created by forcing a liquid through a small hole, the impurities in the waste oil would soon clog this type of nozzle. Therefore, an apparatus was constructed which forces only air through an orifice instead of oil. This uncloggable nozzle is a small orifice at the base of the sphere. The oil is released over the sphere and flows around to meet the orifice at the base of the sphere. The air which is being forced out of the orifice sprays the oil into a mist which evaporates and combusts completely when ignited.

#Fourth Award - ISEF/Environmental Sciences
Alternate - U.S. Department of Energy Trip

OXYGEN PRODUCTION/RECYCLING APPARATUS (OPRA)

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Star Route 2, Box 6116, Tularosa, NM 88352

The purpose of this project was to design and construct a system that would continually produce and recycle oxygen at a level that will sustain life in an oxygen-poor enclosed environment.

In the original system, Chlorella, a unicellular alga, was cultivated to produce oxygen in an oxygen producing and recycling system. A design for the system included an apparatus that monitored the alga and allowed it to thrive, cycled the newly produced oxygen to the closed environment, removed the carbon dioxide using sodium hydroxide as a CO_2 scrubber, and recycled the unused O_2. Once the design was completed, the system was constructed. The alga was added and an oxygen monitor was placed in the closed environment. The pH and temperature were monitored.

An optimum growing environment was created that allowed the algae to thrive. The pH and temperature monitoring systems were effective. the cycling system efficiently carried the newly produced oxygen to the closed environment. The CO_2 scrubber functioned properly and silica gel removed excess moisture from the scrubber. Unused O_2 was recycled back through the system and all meters and pumps functioned properly. The system has the ability to produce and recycle oxygen necessary to maintain the required levels of oxygen needed to support life in a closed environment if the algae thrives and the system of pumps and meters are monitored.

#First Award - Federal Aviation Administration
Second Award - Patent and Trademark Office/U.S. Department of Commerce/Patent and Trademark Office Society
Fourth Award - ISEF/Environmental Sciences

DO BARNACLES HAVE CHEMICAL PREFERENCES ? A FOUR YEAR STUDY

MYLO CARBIA
FORT PIERCE CENTRAL HIGH SCHOOL
2172 WALD STREET,PORT ST. LUCIE, FLORIDA 34984

Barnacles are tiny marine shellfish that attach themselves to sealife, docks, and especially boats.Through four years of experimenting the researcher has tried to find a way to control barnacle growth which could increase fuel costs by 30%. Experimenting for up to 90 days in St.Lucie River, the researcher concluded that white anti-fouling paint and fiberglass repelled barnacles the best and red spray paint and aluminum attracted barnacles the most. During the second year of experimenting, the researcher concluded that barnacles are attracted to darker colors, which absorb heat, and create an ideal enviroment for breeding and growth. During the third year of experimenting, the researcher concluded that "Sears" and "Tri-lux" brand anti-fouling paints were the best of the 12 brand names tested. During the fourth year of experimenting, the researcher concluded that barnacles accumulate approx. 5 times more in the summer than in the fall or early winter. Also, the researcher developed a paint consisting of natural repellants and tested it against anti-fouling paints. Many other experiments were conducted throughout the four years. The purpose of these experiments is to test the possible replacement of fish-harming chemicals that would repell barnacles and be safe for the enviroment as well.

#London International Youth Science Fortnight Trip - U.S. Navy
Scholarship - U.S. Navy
Fourth Award - ISEF/Environmental Sciences

THE EFFECT OF LIPIDS FROM ANATOMICAL PARTS OF PLANTS ON THE PHEROMONIC BALANCE OF INSECTS

Cole, Michael D., Dimmitt High School, Dimmitt, Texas 79027
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For many years people have used several different plants to wart off insects, these things have been handed down for generations. Even though they have been used for many years, people still do not know what is in the plants that repells the insects. In this project I plan to find out what actually does repell the insects. Several different kinds of organic extraction methods will be utalized the isolate the chemical out of the anatomical parts of plants. A few examples are: Steam Distillization, Ether Extraction, and a 1 to 1 combination of Methanol and Chlorophorm. These extractions are then used on various insects so that I can observe their reaction to the chemical that came out of each plant that has been used in this experiment. Then I shall try to find out what the chemical will do when used in a concentrated form, I will find out if the chemical might even kill the insects. I then plan to run test to find out what chemicals I'm using in the experiments. The tests that I plan to use are: Gas Chromatography, Infrared Spectrometer, and an Nuclear Magnetic Resanence machine. These tests will tell me what kind of bonding is present in the chemical that has been extracted from the anatomical parts of plants. By knowing the type of bonding is present in the chemical I can find a few chemicals that are known to be present in these plants and pick one out that I feel is the most likely to be the one that is doing the repelling of the insects.

*A STUDY OF WHEAT TOLERANCE IN RESPONSE TO ENVIRONMENTAL CHEMICAL STRESS

Slabaugh, Mark A., Ogden H.S., Ogden, UT 84403
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This research project was carried out to determine the effect of soil contaminants on the germination of a major agricultural crop (wheat). A great deal of public concern has been expressed in the last few years on the impact of toxic substances upon the environment. While extensive research has yielded much data on the hazards to animal life, there is a need for this same information concerning plant life and future plant life (seeds).

Soil contaminants for this study were selected on the basis of recent public concerns and included: heavy metal ions (mercury and lead), organic hydrocarbons and solvents, and various salts and polyatomic ions.

The procedure involved placing seeds in petri dishes containing an absorbent paper. The appropriate test solution was added to each petri dish to wet the filter paper and seeds. The number of seeds to germinate was determined each day. Several variables which might affect germination were carefully controlled: lighting conditions, temperature, pH, and concentration of ions. To increase confidence in data and conclusions, the averages of three 50-seed trials were plotted for each test condition.

Analysis of data on 54 potential contaminants at four different concentrations revealed that a number of substances such as borate, molybdate, and arsenate ions do inhibit seed germination. Nickel, cadmium, and cobalt ions turned out to be very powerful inhibitors. Several organic solvents such as benzene and trichloroethylene, very surprisingly, had no effect.

*First Award - U.S. Air Force
Fourth Award - ISEF/Environmental Sciences

EFFECT OF THIOBACILLUS FERROXODIANS ON SULFURIC ACID AND COAL

Thornsberry, Jeffry M.
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The problem of acid rain has long been obvious to the people of the northern states. Various solutions to this problem have been suggested but none of these have proven acceptable to the people or the industries who cause the problem. One possible solution is the use of bacterium which will oxidize the sulfur in coal, the prime cause of acid rain.

In phase one of this experiment, it was successfully shown that more Thiobacillus ferroxodians, a bacterium known to oxidize sulfur, were present in a solution where more sulfur was present. In phase two of the experiment, sulfuric acid was used as the sulfur source. It was hypothesized that the pH of this solution would become more neutral over a period of time due to the sulfur oxidation. In phase three, Indiana coal, known for its high sulfur content, was used as the sulfur source. It was hypothesized that if the coal was left in a solution with the bacteria then, when burned, the acid produced by bubbling the gases through the water would have a lower pH than normal coal.

Results from phase two negated the hypothesis. Further research showed that when the bacteria oxidize sulfur they create more sulfuric acid. This would create a much more acidic pH as shown in the results. A spot check of the solution that contained the coal showed that this process was also true.

Results from phase three showed that the hypothesis was true. The treated coal produced a weaker acid when burned. This opens up the possibility of using the bacteria as a means to fight the problem of acid rain.

* BEACH EROSION: THE DEVELOPMENT OF A FULL SCALE EROSION REVERSAL SYSTEM

Widerman, Mark Aaron
Cocoa Beach High School
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The purpose of this project is to develop a full scale structure which will reverse the effects of erosion by altering the flow of water in destructive waves. The researcher hypothesized, based on his previous studies of the effect of the flow of water on specialized structures, that destructive waves could be converted into constructive waves, and a full scale system could be developed which is both ecologically and economically sound.

The researcher perfected the prototype structures developed in his past research, and then investigated the various mixes of cement which would be applicable to the project's structures. It was important that the mix deteriorate after an allotted period of time, thus reducing the level of maintenance necessary, and escaping burial by the undertow. The researcher then molded the structures and placed them in the most effective area, as determined by wave crest formation testing. The different prototypes were checked and recorded every two days, and comparisons were made with current systems regarding cost efficiency and ecological safety. Also tested were the composition ratios of four cement mixes in order to determine the optimum rate of deterioration for erosion reversal efficiency.

***Second Award - ISEF/Environmental Sciences**

EFFECTS OF HERBICIDES ON GEOTAXIC AND PHOTOTAXIC BEHAVIOR IN PLANARIA

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The purpose of the project was to find the effects of various herbicides on the ability of planaria to respond to gravity and light. The herbicides being used are trifluralin (Treflan), imazaquin (Scepter), and atrazine (Aatrex). LD50 tests were performed and the results were: atrazine-8.2 ppm, imazaquin-18.0 ppm, and trifluralin-5.7 ppm. The solutions for the geotaxic and phototaxic experiments were chosen by using 25% and 50% of the herbicide's LD50. Ten planaria were placed in each of the experimental groups and the control group, which was creek water. The geotaxic tests and the phototaxic tests were performed five times, and the results were graphed and statistically analyzed. Based on the results of the LD50 tests, the geotaxic and phototaxic experiments, and the statistical analysis, the conclusion was reached that the herbicides atrazine, imazaquin, and trifluralin significantly affect the planaria and their geotaxic and phototaxic behavior. According to Mr. Robert Eck, Missouri Department of Natural Resources, these levels could definitely be reached in a natural environment. Therefore, the effect of these herbicides could cause the planaria to die or to lose their natural geotaxic and phototaxic responses, which would put them in danger of being killed.

IS RADON A PUBLIC HEALTH RISK IN SCHOOLS?

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The purpose of the project is to determine if radon, a radioactive gas occurring naturally in soils, is present in the classrooms of the Pojoaque Valley School System at levels that would pose a public health risk to the students and staff.

The hypothesis is that there may be a high probability that the radon levels in the classrooms of the Pojoaque Valley School System will equal or exceed the action level of 0.02 Working Levels (WL) established by the US Environmental Protection Agency.

During recent surveys of private homes in the surrounding communities, high WL's were detected by the New Mexico Environmental Improvement Division.

The following materials were used: (13) WLM/1 alpha particle radon detection units, (1) WLR/1 Working Level Readout Unit, (13) classrooms.

The survey procedure was designed to sample representative classrooms located on the school grounds. The testing was conducted during the winter month of February representing the highest concentration of radon present throughout the year.

The WLR/1 readout unit provided the computerized analysis of each WLM/1 Radon unit. The actual radon levels range from 0.004 WL's to 0.017 WL, the highest reading.

In conclusion, the presence of radon was detected at each test location in every classroom; however, the hypothesis that high radon levels were probable was not confirmed by these tests. As a result, no further protective measures were recommended.

* Induction and Prevention of Chilling Injury to Radical Tips

Rebecca Anne Burger
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Purpose-To determine the effectiveness of a presoaking period in preventing chilling injury by exposing cotton seeds (Gossypium hirsutum) and soy beans (Glycine max) to various temperatures for varying lengths of time.
Hypothesis-Soaking before chilling will prevent nub root injury.
Procedure-This project was divided into 2 sections. The first, using cotton seeds, was then divided into 4 phases or smaller experiments. The second section, using soy beans was divided into 5 smaller experiments.
In Experiment 1 using both kinds of seeds 2 groups of seeds were soaked, a control at 31°C (88°F) for 3 days, and a variable 5°C (41°F) for 24 hours then 31°C (88°F) for three days. Control had greater growth.
In Experiment 2 using both kinds of seeds different groups of seeds were chilled at 5°C (41°F) for increasing periods of time. Those chilled for less time or not at all had greatest growth.
In Experiment 3 using both kinds of seeds different groups were soaked for increasing periods before chilling. Those that were allowed to soak for the longest time before chilling had greater growth.
In Experiment 4 using both kinds of seeds different groups of seeds were weighed and observed. They were then soaked for increasing periods of time and then reweighed. After this they were chilled. Those allowed to absorb more had greater development.
In Experiment 5 using only soy beans, seeds were soaked and then dried. After this they were chilled. Those absorbing more water before drying had greater growth.
Conclusion-Adequate soaking seeds prior to chilling will reduce nub root injury.

*Third Award - ISEF/Environmental Sciences

TITLE: Comparative Biodegradation of Similar Toxic Compounds
AUTHOR: Leonard, Jordan
SCHOOL: Lincoln Senior High School - Sioux Falls, South Dakota 57105
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While American industry generates 200 million tons of toxic waste each year, only ten percent of it is handled and disposed of in a safe manner. We ingest man-made chemicals in the food we eat, the water we drink, and in the air we breathe. One reason for the mishandling of toxic wastes is that there has been no effective and efficient way of dealing with the poisonous substances. In this two-year study I first determined if the anaerobic digestion of a toxic compound, namely xylene, was feasible. After that was established, I set out to determine if other toxic compounds would also be degradable.

An environment for bacteria growth was prepared by adding a buffer solution to the growth chamber which was then purged with a gaseous solution of methane and carbon dioxide to remove oxygen. Then seed sludge containing the anaerobic bacteria was added to each bottle. With one bottle remaining as the seed control, ethanol and a varying concentraion of the toxic chemical was added to each of the remaining bottles. The gas production was read at regular intervals with a manometer and the results recorded. This test showed the breakdown of xylene was small in most bottles. The other toxic compound, toluene, showed a greater breakdown with less gas production by anaerobic bacteria.

I concluded that anaerobic bacteria in the seed sludge were able to digest xylene, but toluene inhibited other bacteria in the biodegrading process.

THE EFFECTS OF ETHYL ALCOHOL ON LITTORINA IRRORATA

White, David R.
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In the life of the Littorina irrorata, sometimes called the marsh periwinkle, the ability to right itself when upside-down is essential to life. If the L. irrorata were embedded upside-down in the mud above the water level, it would be unable to probe the mud for food or to get back into the water where it finds its needed supply of oxygen. If the snail were disoriented, physically out of control, or physically depressed, it would not be able to turn itself over. Thirty periwinkles were exposed to concentrations of ethyl alcohol ranging from .1% to .5% for one hour. After each fifteen minutes, the snails were placed upside-down and a time was recorded when one half of the snails had righted themselves. At .1% and .2% concentrations, the effects of the ethyl alcohol were slight; but after being exposed to concentrations of .3% to .5%, the snails reacted drastically, many not turning over even after two hours. A spill of pollutants containing very, very minute amounts of ethyl alcohol would be relatively harmless to L. irrorata, but amounts of 1% or more would be fatal.

ECOLOGICAL STUDY OF CACAO HAYSTACK HILL COMMUNITY IN THE NORTH-WESTERN AREA OF PUERTO RICO WITH SPECIAL ATTENTION TO THE INTER-RELATION OF ITS SPECIES

Guzmán, Jennifer
Juan Alejo de Arizmendi High School
Calle 2-737-Urb. El Retiro - Quebradillas, P. R.

The purpose of my investigation is to determine if the distribution of the flora and fauna in the haystack hill which has been afected by the environmental parameters, soil conditions and man's impact on the environment.

Determination of species was done using quadrant and transect methods, climate and edaphic parameters were measured using climatological instruments and soil measurement kits. Species of plants and animals were preserved and photographed directly on the field. Study of the flow of matter and energy was done through the direct observations of energy pyramids, food chains and webs establishing the interrelation of its species.

The investigation reveals that within three acres of land we encounter the following: 104 genus, 127 plant species belonging to 42 families, 19 butterflies species, 34 insect species, 5 lizard species, 7 snail species, 4 millipede species, 1 centipede species, 19 bird species, 7 spider species. All results were measured and dated statistically.

WATER POLLUTION IN OUR CITIES

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Water Pollution is the contamination of water by foreign matter. Every type of lake, stream, river, or pond has pollutants in it, both natural and unnatural. In the case of the Rouge River, the bad outnumber the good.

There are three main parts of the Rouge; the lower, the middle, and the upper Rouge. There are many tributaries that empty into the Rouge, and many hidden places where people can dump their undesirables. The purpose of this experiment is to see what part of the river is most polluted, and if the degree of pollutants changes in the waters path.

The experimentation process was a timely one. Six water quality tests were performed on 10 different cities throughout Wayne County, Michigan. This process was repeated each weekend during 3 consecutive weeks. The results were then compared. The tests proved that the Main Stem is the most polluted, and that the amount of pollutants does not vary much along the 3 paths of the Rouge.

THE EFFECTS OF MICROWAVE RADIATION ON *DROSOPHILA MELANOGASTER*

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A study was done to determine the following: the effects of high level microwave radiation (produced by a household microwave oven/ 30-S) on the phenotypic expression of the offspring produced by radiated parents (*Drosophila melanogaster*: white-eyed mutant); whether this radiation affects the survival rate of the radiated parents: and whether microwave radiation causes a significant amount of sterility.

Cultures of *Drosophila melanogaster* were obtained from a biological supply store. One-thousand flies were tested under varying dosages of microwave radiation, to determine a safe, yet adequate dosage for testing. A half-minute dosage was selected on the basis of maximum toleration-level withstood with production of viable offspring. Three vails (comprised of one set of parents each) were prepared for the second stage of testing. The parents (virgins) were kept in these vials for two days to allow them to mature and mate before exposure to microwave radiation. Selected flies were radiated. These flies were then rejoined with their previous mates. The parents were removed after four days, and the flies subjected to a second dose (this was to be done every four days until the death of the flies). When the flies emerged, they were observed, counted, and recorded in data logs; next, the flies were immediately sacrificed.

The results showed that microwave radiation caused a significant number of *Drosophila melanogaster* (offspring) to have phenotyic mutations after exposure. Flies subjected did show signs of stirility in that the number of offspring of the radiated flies were significantly less than that of the normal count; the mutations became more complex with additional radiation to these offspring. The male to female ratio (50/50) was not significant when compared to the expected ratio.

A STUDY OF THE EFFECTS OF MAN-MADE STRUCTURES ON BEACH EROSION

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The purpose of the researcher's project was to determine which type of man-made structure is the most beneficial to barrier islands. The researcher has built a functioning motorized wave tank in order to test the effects of jetties on beach erosion. The study was focused on the performance of three basic types of jetty design (straight, curved and ninety degree angle) and their placement in the water (into the current and away from the current). The jetties were built in sets of three per design. A baffle system was developed to simulate three types of ocean currents: longshore left, longshore right, and mid/ocean shore. A twelve by six inch barrier island was built and the effects of five different structures were tested in longshore left current and on high speed. For each experiment the motor ran for ten minutes. Results indicated that curved jetties facing away from the current caused the least amount of erosion while curved jetties facing into the current caused the greatest amount of erosion. Applying this informaiton to conservation of our barrier islands could improve their chances for survival.

*Second Award - Association for Women Geoscientists Foundation
Fourth Award - ISEF/Environmental Sciences

INFLUENCE OF ZEOLITE AS A SOIL ADDITIVE FOR FERTILIZER RETENTION

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The use of fertilizers in agriculture can dramatically increase crop yields. But, portions of applied fertilizers may be removed from the soil by leaching or runoff. This results in a financial loss to the farmer as well as posing a growing water pollution problem. The purpose of this research was to determine if combination applications of the mineral zeolite and fertilizers would increase soil retention of fertilizers for future plant uptake.

Phosphate and nitrate fertilizers were used in combination with potassium zeolite. All application levels approximated field conditions. Experimentation included germination studies and test production to observe effects of zeolite on crop yields. Soil fertilizer retention with zeolite involved studies on surface versus subsurface fertilizer losses and water drainage rates. A survey of fertilizer levels in the Snake and Owyhee Rivers was run.

#First Award - U.S. Navy
Second Award - National Water Well Association
Second Award - Water Pollution Control Federation

Ochromonas: A Biological Control of Anabaena

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Eutrophication has become a greater problem in recent years due to increased pollutants in run-off from the water shed. In addition, there are reports that certain species of algae are toxic. Thus developing a way to help maintain the balance of vegetation and fish life in lakes is vital. Many attempts have been made to control this problem of eutrophication by nuisance species of blue-green algae. Some have succeeded, but the algaecides produced are also harmful to other aquatic life. Ideally, the algaecide should have an economical cost, be safe for applicators, be non-persistant and be non-injurious to other aquatic life. Algaecides used today do kill blue-green algae, such as chelated copper, but are quite harmful to other aquatic life. To keep from killing the the entire lake or pond, applicators must treat half the lake at a time. Thus, another ideal property for an algaecide would be to only treat the lake once. If an algaecide were developed that met all the ideal properties, then the problem of eutrophication by blue-green algae would be practically obliterated. Dow Chemical Company observed an organism named Ochromonas consuming Anabaena. The objectives of my experimentation are to quantify and analyze this phenomenon. Small scale in vitro experimentation has been compleated. The results have been tabulated and a significant difference was found between the Anabaena control and the experimental. The same experiment was carried out on a larger scale. This experiment was conducted in ten gallon (40L) aquaria. The results were similar to the previous experiment in that the Anabaena would over populate in the control group. However, the Anabaena added to Ochromonas would decrease in population. Experimentation on an actual pond is being conducted.

#First Award - American Water Works Association
First Award - Water Pollution Control Federation

*SOIL EROSION: A CRITICAL PROBLEM

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Farming sandy soil and loam without soil loss from wind erosion is the focus of this project. I built four boxes, 8' by 1', and planted barley in two. The barley was planted latitudinally, about 4" apart, which allowed the wind to blow across the rows. Of the two boxes, one was planted in top soil and one in sandy soil. The two samples grew to about 2" tall. The wind was created by a half horse furnace fan which blew at a velocity of 30 mph. I placed the soil samples between a wall and two windows, 6' by 4', which leaned against the wall. I built a snow fence on one end to serve as a wind break and to slow down the blowing dirt particles. I also built a chimney at that end which allowed the air to escape. The fan was placed at the opposite end to complete the wind tunnel.

The other two boxes contained no vegetation. One consisted of top soil and the other of sand. The results concluded that the sand plot with vegetation lost .5 cubic cm. of soil while the sand plot without vegetation lost 14 cubic cm. In the topsoil plots, the one with vegetation had no soil loss but the one without vegetation lost two cubic cm. of soil.

My experiment proved that vegetation is needed to reduce soil erosion. The best method to stop land erosion is to plant grass and allow the soil to replenish.

*Honorable Mention - Eastman Kodak Company

ENVIRONMENTAL STUDY OF TWO MARINE ECOSYSTEMS: THE MUD FLATS AND ROCKY BEACHES WITH EMPHASIS TO PATHOLOGICAL AFFECTIONS AT THE POPULATION

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The main idea of this pursues to determine the affections caused in the saline organisms and the rocky coasts by contaminated agents that accumulate on the marine sustrate Four stations were selected at random: Pastillo, La Guancha, El Tuque and Caña Gorda Out of these, Pastillo and Caña Gorda possess salines from which the following organisms were collected: *U thayeri*, *U. leptodactyla*, *P hepaticus*, *N virginea* and *A. nitida* One hundred percent of the organisms collected are equivalent to a 230 populational sample out of which 70% resulted in organism with morphological physiological and cytological abnormalities The major part of the contaminants found in the ecosystem were solid recyclables and in the flame test the following metals were identified: aluminum, sodium, copper, calcium, potassium and manganese. In relation with the rocky coast many organisms were collected at Caña Gorda, La Guancha and El Tuque stations such as: *E lucunter*, *E. viridis*, *C ornatus* and others. The populational sample taken by means of transecs was of 413 organisms. Out of which 0.90% resulted with abnormalities. The accumulation of sediments on the algae was obvious. When the flame test was accomplished the following metals were identified: rubidium, sodium, potassium, copper, calcium and manganese. When the chromatographic study on the algae and sensibility test with the echinodermata were performed aminoacids were found useful to the human diet and bactericidal properties on the echinodermata.

* THE EFFECTS OF POLLUTION IN MIDDLE ATLANTIC REGIONAL WATER SOURCES ON PHOTOSYNTHESIS

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Realizing the disastrous results of large scale pollution, like that along the Atlantic coastline last year, it was wondered how regional water sources were affected by pollution. Therefore, a study began to determine: the effects of pollution in Middle Atlantic regional water on photosynthesis; the optimum light intensity for O_2 production; and the variation in pollutant intensities between the seasons of fall and spring.

In phase one water was gathered from numerous regional water bodies. Five test tubes were filled with water from a site, and an 8cm sprig of Anacharis was added to each test tube. Each set of five test tubes was exposed to 500 lumens of light at 25°C for two hours and the amount of O_2 produced was measured. In phase two the water was tested under 1000, and 1500 lumens of light. In phase three the same procedures were followed using spring water samples and the results were compared to those of fall.

Of the water tested, the Hudson River produced the highest photosynthetic rate while the Chesapeake Bay caused the lowest. Other results showed that: the photosynthetic rate depends on the pollution level, both natural and man-induced; O_2 production rises as light intensity increases; and water from spring is responsible for higher photosynthetic levels than fall water. A statistical analysis of fall water samples under 500 lumens at 25°C had a standard deviation of .60ml for O_2 production. The deviation under 1000 lumens was .53ml, and 1.16ml for 1500 lumens. Spring results had standard deviations of .63ml for 500 lumens, .66ml for 1000 lumens, and 1.01ml for 1500 lumens. The fractional differences in these figures show that despite an overall increase in O_2 production from fall to spring, the amount of deviation within the two is fairly consistent.

By applying these results, corrective measures can be taken to save our invaluable water sources so that they may continue to promote life.

*Honorable Mention - Federal Aviation Administration

NITRATE CONTENT AND SOURCES IN TWO ESTUARIES

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Nitrate levels are a determining factor and an essential nutrient for plant growth in equatic systems, although abnormally high levels may lead to massive algae growth, loss of benthic oxygen, and the consequent death of the water's inhabitants. To determine the primary nitrate contributors of the Niantic River and Jordan Cove, the volume of entering water and the nitrate contents of the Long Island Sound and various streams opening into the two estuaries were analyzed and the results recorded. Nitrate content was examined by means of the Hach cadmium reduction method and a light spectrophotometer. The volume of water entering the two estuaries from each source was determined by multiplying the crossectional depth of the stream or Sound mouth in question by its appropriate flow rate. Summer nitrate exporting was found to be primarily the responsibility of the Long Island Sound in the Niantic River, while the Sound and streams shared about equally in summer Jordan Cove nitrate exporting. In the spring, however, Jordan Cove was dominated by high nitrate levels in the streams. This indicated strong seasonality in Jordan Cove, with a possibility of seasonality in the Niantic River. The conclusion that can be drawn from this is the necessity of determining a policy of caution in introducing fertilizers and nitrate rich materials to the land around Jordan Cove during the spring. The central portion of the Cove, already containing algal mats, could be a herald of things to come if further nitrate excesses occur in Jordan Cove.

* THE EFFECT OF FERTILIZER RUN-OFF ON POND ECOSYSTEMS PHASE II
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My research was conducted to determine which of the components in chemical fertilizers is the most inhibitory. I predicted that nitrogen would be the most inhibitory to the pond fauna and flora. To test my hypothesis, I constructed a set of ten simulated ponds. Each pond was stocked with elodea, duckweed, five pond snails, ten amphipods, ten planaria and twenty five daphnia. Three square feet of sod was established in wooden boxes to simulate the plant zone around the ponds. The boxes were placed at a slant and a small section of hose was inserted in one end to direct run-off into the ponds. In this experiment I used three lawn and four agricultural fertilizers. The four agricultural fertilizers included: 12-12-12, 46-0-0, 0-45-0 and 0-0-61. The three single ingredient fertilizers were used to isolate the specific effect of each component, nitrates, phosphates and soluble potash. A solution of the recommended amount of fertilizer was applied to the grass. Two plots of grass, which didn't receive any fertilizer were used as controls. The one remaining plot was used to help support an alternative to the use of chemical fertilizers and was fertilized with dried cow manure. For six weeks, I tested water samples for nitrate and phosphate levels with a HACH water test kit. I counted the number of surviving invertebrates and observed the growth of the flora in each pond weekly. My research indicates that nitrates are directly inhibitory to the fauna and flora of simulated ponds. None of the invertibrates survived in any of the ponds receiving nitrogen run-off while they multiplied in the controls and the high phosphate and potash ponds. The organic fertilizer stimulated the flora and fauna without polluting the water with chemicals.

*First Award - ISEF/Environmental Sciences
Honorable Mention - Eastman Kodak Company

COMPARATIVE STUDY ABOUT THE POPULATION DENSITY OF CARDISOMA GUANHUMI IN DIFFERENT AREAS OF P.R. EMPHASIZING THE CAUSES OF ITS POSSIBLE EXTINCTION.
Rivera Rosa, Jouhan, John F. Kennedy High School, Box 601,
Santa Isabel, P. R. 00757

The principal purpose of this research is to determine the influence factors in the extinction problem challenge by the Cardisoma guanhumi. I studied the population density of this specie in different areas of the island of Puerto Rico. The Cardisoma guanhumi commonly known as "crab", live in plane and humid terrains of the coastal areas in the tropical zone of the Occidental Hemisphere. The commercial hunting of this specie is an important source of food and protein for the population of Puerto Rico in this century. Another purpose of this study is to demostrate that different articial substracts present in the natural habitat of Cardisoma guanhumi have influenced in the possible extinction of this specie. I traced a quadrat of twenty-five meters wide by fifty meters long. I marked with numbers the caves (holes in the ground) and after this, I measured them with a Vernier caliper in centimeters. According to the data obtained and to its analysis, I can generalize that for the reproduction and maintaining of the Cardisoma guanhumi specie, the following conditions have to be observed: the U. S. Fish and Wildlife SErvice can promulgate a law to protect the species; mainly in the invernation state of the Cardisoma guanhumi; also, the industries that depend on a direct cooling system can find alternate methods to avoid the direct discharge of the cooling cycle to the sea. I suggest the use of breeders to reproduce the specie in a better condition and to seed it in appropiate areas of Puerto Rico and other tropical adjoining areas.

* CYTOGENETIC EFFECTS OF ENVIRONMENTAL RADIATION

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The purpose of this research was to determine the effects of environmental radiation on the production of chromosome aberrations in plants, and to evaluate biological doses from dicentric chromosome yields in human peripheral lymphocytes following irradiation.

In Phase I, seeds of three species of plants were exposed to varying doses of gamma, ultraviolet, microwave, magnetic and X-radiation. The seeds were germinated and the chromosomes in the root tips were examined. I calculated the percentage of cells with aberrations for each dose, and determined that the chromosomal aberration yield was proportional to the dosage of radiation. The ionizing radiations were the most effective in producing aberrations. The only radiation which did not induce chromosome aberrations was the electromagnetic field; however, I would have to expand my experiment to look for mutations before concluding that magnetic radiation does not cause any genetic damage.

In Phase II, slides of human lymphocytes which had been exposed to 75, 150 and 300 rad X-radiation were scored to determine the dicentric chromosome yields. A statistical analysis of the data was performed and dose response calibration curves were utilized to make an estimation of equivalent whole body dose. My data indicate that the dicentric yield increases with the dose. The number of aberrations per cell increased from .0633 at 75 rad to .9267 at 300 rad. The agreement between the estimated dose and the actual dose was within the 95% confidence limits for all points. The data show that the values are consistent with a Poisson distribution.

*First Award - Eastman Kodak Company
Third Award - ISEF/Environmental Sciences

THE IMPACT OF ALLELOPATHY IN AN AGROECOSYSTEM

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Recent research suggests that allelopathic chemicals may directly influence crop emergence and growth. Other inhibitory reactions in agroecosystems work through a variety of methods. Nearly a hundred weed species have been identified as exhibiting allelopathic potential. Crop residues produce toxins that affect crop performance in a no-tillage system. In addition, many plants release inhibitory chemicals that can regulate nitrogen availability in soils.

My experimental research involved a series of experiments designed to determine allelopathic relationships within an agroecosystem. The primary emphasis being on the inhibitory influence to seed germination, shoot and root growth, and comparing how long these inhibitory toxins remain in loam, sandy loam, and clay soils.

To test my hypothesis, I prepared an extract of water-soluble chemotropic agents from the seeds of Poa pratensis. This extract was used to test inhibitory reactions on wheat, barley, millet, and sorghum grown in three different soil types.

Results of these experiments led to the conclusions that soil treated with allelopathic chemicals yielded a sixty-to-eighty percent reduction in seed germination as well as shoot and root growth during the first two weeks. A forty-to-fifty percent inhibitory influence still existed up to five weeks. Seed germination was inhibited more in the clay soils, while the loam soils showed a higher inhibition on shoot and root development. Such results make it apparent that the impact of allelopathy in an agroecosystem is extremely important to our efficiency in agriculture.

* MEASUREMENTS OF ENVIRONMENTAL FACTORS AT POLLUTION SOURCES ON THE PAWTUXET RIVER

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The river on which the study was conducted is the Pawtuxet River. This river has been the topic of much controversy concerning environmental pollution in the past. This is due in part to its unsanitary appearance, its odor, and its load of industrial effluent.

Seven locations on the river have been designated. At these stations water temperature, phosphate content, dissolved oxygen level, and pH were recorded in the field. Water samples have also been collected for further examination under lab conditions to study microscopic life and coliform bacteria levels.

Two months of field testing have been conducted. Four dates were chosen to meet the following requirements: 1) seasonal fall weather with no precipitation over a five day period, 2) seasonal fall weather after a heavy rainfall, 3) seasonal winter weather with no precipitation over a five day period, 4) seasonal winter weather after a heavy snowfall.

Results indicate a large difference in both coliform and dissolved oxygen levels between the stations. There was much less variability in phosphate, temperature, and pH at these locations. After precipitation there was an increase in dissolved oxygen and coliform content at most of the sampling stations. These results may indicate a seepage of untreated sewage from septic systems into the river.

*Third Award - ISEF/Environmental Sciences
Honorable Mention - Bureau of Reclamation/U.S. Department of the Interior

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* METAL SALTS IN PUERTO RICO: INTERACTION ON SEVERAL SPECIES OF PLANTS AND TOXIC EFFECTS OF Ni $(NO_3)_2$

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Different metalic salts as follows, copper sulfate, ferric sulfate, zinc sulfate, nickel nitrate, copper nitrate and mercuric chloride were used to perform the study. To demostrate the possible effects of these metals on plants as cucumber, bean, sorghum and tomato, analysis of germination, development and growth were conducted as well as chemical and histological analysis, at different periods, of study Ni $(NO3)_2$ cause the worse effects. The toxic symptons observed were clorosis, necrotic spots in juvenile leaves and between ruts at histological levels.

Differential concentrations of $Ni(NO3)_2$ were used under the same periods of study, finding that a higher concentration reflected a smaller primary root, while a smaller concentration produced a smaller hypocotile. Morphological analysis were done to acuatic plants at the same $Ni(NO3)_2$ concentration produced a smaller hypocotile. Morphological analysis were done to acuatic plants at the same $Ni(NO3)_2$ concentrations used before. Significative results were found after submitting the soils to chemical tests. The technique of atomic adsorption spectra is being used to determine the metalcontent in the celular tissue of Phaseolus vulgaris treated with different concentrations of $Ni(NO3)_2$.

*First Award - Eastman Kodak Company

-CORROSION IMPACT ON THE ENVIRONMENT-THE MOVEMENT OF HEAVY METALS THROUGH THE SOIL IN SALVAGE YARDS

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Large Quantities of automotive parts in salvage yards undergo reaction with acidic rainwater to produce corrosion. As a result, heavy metal species are released to the environment, or combined with other elements to form compounds which can leach through the soil. The purpose of this project is to investigate the presence of heavy metals in the soil and water, both inside and around a salvage yard in the city of Tulsa, Ok.

Three surface samples from the area surrounding the yard were analyzed after extraction using an Inductively Coupled Argon Plasma (ICP) Spectrometer. With the confirmation of the presence of heavy metals, other core samples to a depth of 60 cm. were obtained from both inside and outside the salvage yard. The results indicated elevated levels of Cr, Ni, Cu, Pb, and Zn. The soil pH equalled 6, which could indicate favorable conditions for further leaching of heavy metals.

The runoff area contained significantly higher levels of lead and zinc (3000 mg/kg of lead, 4000 mg/kg of zinc) than samples inside the yard. This contaminated runoff flows through a nearby stormwater basin and the Flat Rock Drainage Basin, into Bird Creek and the Verdigris River. Such contaminated water contributes a hazard to plant and animal life in the area, and has detrimental effects on the children who play near the salvage yard. The runoff may also pollute groundwater reservoirs, nearby farmland, and wildlife preserves.

This preliminary research indicates a need for monitoring unexpected sources of contamination, and perhaps suggests the need for an establishment of zonning regulations for the placement of salvage yards.

*First Award - American Society of Agronomy
Third Award - Association for Women Geoscientists Foundation
Third Award - ISEF/Environmental Sciences

COMPARING TRACE ELEMENT CONTENT IN TREE LEAVES

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This project was performed to determine whether or not there is a significant difference in trace element content of tree leaves from the summer to the fall season. This could be of interest to orchard growers or others who farm trees. Five species of trees were used, and a total of fifteen samples per season were taken. These leaves were obtained from several locations in and around Wamego, Kansas. The completely dried samples were sent to the Kansas State University Triga Mark II Nuclear Reactor Facility for a qualitative and quantitative analysis of nine elements in the leaves. The elements that were tested for were: sodium, chlorine, bromine, strontium, magnesium, potassium, lanthanum, antimony, and arsenic. When the results.were obtained, a two-sample T-test was performed for each element, to determine if there is a difference between the seasons.

It was found that no large or significant amounts of lanthanum, antimony, or arsenic were found in the leaves. Also, as a whole, there was no significant difference in the trace element content from one season to the next. There were differences in three individual samples that were determined as significant. This data suggests that the season does not, as a whole, affect the amount of trace element content in tree foliage.

ELF WAVES: THE CURRENT CONTROVERSY

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Effects of extremely low frequency (ELF) wave exposure to living cells have not been will documented until recent years. The purpose of this project is to determine if ELF wave exposure to two types of plants--*Phaseolus coccineus* and *Hibiscus esculentus*--during germination procured any permanent mutation. Procedure involved, first, research on ELF waves. Letters to experts in ELF fields were written and news articles were collected from which a hypothesis was formed and a research paper was written. Hypothesis formed was: ELF wave exposure to *P.coccineus* and *H. esculentus* would result in stunted growth. The next step in procedure involved building a device to measure ELF fields. The third step included experimentation--Ac and Dc ELF wave exposure to *P.coccineus* and *H.esculentus*. Ac ELF waves were produced by an electromagnetic coil connected to an Ac outlet. Dc ELF waves were produced by a 6-volt lantern battery connected to an electromagnetic coil. Each test group was irradiated for 5, 10, and 15 minutes; and the average lengths of each group's roots were recorded and plotted on graphs. The t test was then performed on the test groups. Results of graphs and t test indicated 1) enhanced and stunned growth and 2) significant differences in the t test.

Conclusions derived were 1) ELF wave exposure to *P.coccineus* and *H.esculentus* even at low levels can be hazardous for ELF waves produced unpredictable results and 2) changes induced by ELF wave exposure is independent of the time exposed.

THE EFFECT OF REVEGETATION WITH UNIOLA PANICULATA ON SAND ACCRETION IN A COASTAL ZONE - A FOURTH YEAR OF STUDY ON BEACH EROSION

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AS UNDERSTANDING OF THE IMPORTANCE OF SAND DUNES IN PROTECTING THE LAND FROM THE SEA INCREASES, GREATER EFFORTS ARE BEING MADE TO PROTECT NATURAL SAND DUNES AND TO ENCOURAGE DUNE DEVELOPMENT ON ALREADY ERODED BEACHES.

AFTER TWO YEARS OF STUDYING THE EFFECTS OF WAVE EROSION ON THE COASTLINE, THE FOCUS OF THIS PROJECT WAS CHANGED TO WIND EROSION IN ORDER TO EVALUATE THE EFFECT OF BEACH REVEGETATION ON DEVELOPMENT OF SAND DUNES. AN AREA ON HALLANDALE BEACH, FLORIDA, NEWLY REVEGETATED WITH UNIOLA PANICULATA (SEA OATS), WAS CHOSEN FOR STUDY. EIGHT SPECIFIC POINTS WITHIN THE REVEGETATED AREA WERE SURVEYED FOR TEN MONTHS. SURVEYING WAS CONTINUED FOR A SECOND YEAR TO ACQUIRE FURTHER INFORMATION ON THE DUNE DEVELOPMENT IN THE AREA. TO AMPLIFY DATA EIGHT MORE EXPERIMENTAL POINTS, LOCATED WITHIN THE REVEGETATED AREA, WERE ADDED. THE PROJECT WAS ADDITIONALLY EXPANDED TO INCLUDE EIGHTEEN POINTS IN VARIOUS LOCATIONS ON THE BEACH TO SERVE AS CONTROLS. SURVEYING WAS CONDUCTED MONTHLY FOR AN ADDITIONAL SIX MONTHS. READINGS WERE RECORDED IN A LOG BOOK ALONG WITH PERTINENT INFORMATION CONCERNING SPECIFIC POINTS AT THE TIME DATA WAS COLLECTED. WEATHER CONDITIONS WERE NOTED. DATA WAS ANALYZED AND GRAPHED TO DISPLAY THE RESULTS.

FLUCTUATIONS IN THE PERIODIC MEASUREMENTS DEMONSTRATED THE CONTINUOUSLY CHANGING PROFILE OF THE BEACH. REVIEW OF THE DATA CONFIRMED THAT SAND ACCRETION HAD OCCURED AT FOURTEEN OF SIXTEEN EXPERIMENTAL POINTS. EIGHT CONTROL POINTS SHOWED A DECREASE IN ELEVATION. OF THE CONTROL POINTS WHICH GAINED SAND, SEVEN WERE LOCATED IN CLOSE PROXIMITY TO THE SEA OATS, INFERRING A POSITIVE AFTEREFFECT OF THE REVEGETATION PROJECT.

VIABILITY OF PESTICIDE UTILIZING MICROBIOTA IN SOILS

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The agricultural industry relies heavily on the use of pesticides to enhance production. Their use has played an important role in making Americans the best fed people in the world, and at a very reasonable cost. At the same time, however, adverse effects from their use have been observed, including contamination of surface and ground waters.

This paper reports the results from a study directed toward testing the hypothesis that both pesticide treated and non-treated agricultural soils contain microbes capable of utilizing a variety of pesticides as substrates. Agar plates containing one of four pesticides (Lorsban, Malathion, 2,4-DB, and Treflan) were inoculated with serial dilutions from a solution made by adding one gram of each of six soils to nine milliliter aliquots of a sterilized solution. Naturally occuring colony forming units capable of growing on each pesticide agar were enumerated after seven days incubation.

The soil bacteria were able to use each of the four selected pesticides. The total population appeared to vary with soil types. The total number of bacteria appeared to be correlated to the crop grown and soil texture. The bacteria were more capable of utilizing the organophosphate pesticides Malathion and Lorsban and less capable of utilizing 2,4-DB and Treflan.

#Fourth Award - ISEF/Environmental Sciences

Analysis of $CuSO_4$ Effects on Grass Shrimp: Two Year Study

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Copper sulfate ($CuSO_4$), proposed as a herbicide to control hydrilla growth, was tested for its lethal effects on larval, juvenile, and adult grass shrimp, Palaemonetes pugio; and 96-hour median lethal dosages (LD_{50}) were determined for each stage. Larval populations of P. pugio were exposed to concentrations of 0, 1, 2, 4, 6, 8, 10, and 100 ppm; juveniles to 0, 1, 10, and 100 ppm; and adults co 0, 50, 100, 150, 200, 300, and 400 ppm. Using an atomic absorption spectrophotometer, analyses for Cu^+ and Cu^{++} were perfomed on several estuarine water samples, pre- and post-test water samples, and shrimp tissues.

By graphical interpolation, the LD_{50} of P. pugio larvae, juveniles and adults was determined to be approximately 2 - 6 ppm, 40 ppm, and 180 ppm, respectively. The Sign-Test showed that differences between amounts of copper in pre- and post-test water samples were not significantly higher (Rank Sum Test) than that of the control group. The difference in amounts of copper between experimental shrimp with and without gills was not significantly different (Rank Sum Test). These results indicate that copper is not only accumulated in the gills as a precipitate, but may also be absorbed into other tissues, ultimately resulting in death.

#Honorable Mention - American Statistical Association

#'EFFECTS OF THE SAN MANUEL SMELTER ON TREE GROWTH'

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In 1956 a copper smelter opened in San Manuel Arizona. Since that time the Smelter has produced not only copper but sulphur dioxide and other pollutants. The effects of pollution have been noted throughout the world by tree labs. These tree labs have noted decreased tree growth and certain trace elements in tree composition. The trace elements are one of the indicators of pollution. The Santa Catalina Mountain range is located a few miles away from the smelter. It was the purpose of my science fair project to discover the effects of the smelter through growth patterns and trace elements in trees in these mountains.
In mid January of 1988 I went to the Catalina Mountains and collected wood samples from lumbered trees. I cross dated these samples using precipitation data from the Tucson Magnet weather station. This data indicated the dry and wet years representing thin and thick rings respectively. I grouped the rings into ten year increments and measured them to the nearest tenth of a mm. In order to determine if any trace elements were present, I irradiated samples at the U of A nuclear reactor and the parts per million of the elements were determined. I analyzed my samples for an increase in the trace metals looking for the effects of pollution. I determined from the data collected that tree growth has decreased linearly with increased production by the San Manuel Smelter.

#Fourth Award - ISEF/Environmental Sciences

#PLANTS AND THE GREENHOUSE EFFECT

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My experiment was conducted over eight weeks. Fifteen varieties of plants were used to determine how a wide range of plants would react to the changes which are occuring in our atmosphere due to the Greenhouse Effect. Sixty plants were grown in an airtight enclosure while another sixty identical plants were grown in an enclosure into which triple the normal concentration of carbon dioxide was induced; this was to simulate the predicted levels of carbon dioxide over the coming centuries. Each week, the plants were observed and their general condition of health was recorded along with measurements of height, width, and amounts of water used. A computer program was written to help in the manipulation and analysis of the data which had been compiled during the experiment.

It was found that the extra carbon dioxide had a very definite effect on the health of the plants, and on how quickly the plants matured. The extra carbon dioxide affected the growth of the plants most when they were very young. All varieties were affected differently from each other. For tall thin plants, there was a definite increase in their height growth rate, while for small bushy plants, the extra carbon dioxide contributed to better leaf development. Those plants in the carbon dioxide enriched environment also had significantly higher root development. Plants that use the C4 pathway for photosynthesis did not seem to be affected any differently from those plants that use the C3 pathway for photosynthesis.

The most important conclusion to be made from the experiment was the fact that regardless of whether a plant will use more or less water in the future, the ratio between growth rate increase and water usage will be greater.

#First Award - U.S. Department of Energy

* EFFECTS OF HALOGENATED HYDROCARBONS ON RUMEN MICROORGANISMS

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Halogenated hydrocarbons such as polychlorinated biphenyls (PCBs), heptachlor (HEP), 1,1,1-trichloro-2,2-bis(p-chlorophenyl)-ethane (DDT), and pentachlorophenol (PCP) have become environmental contaminants, and at times, can move up the food chain. Cattle have been contaminated in a variety of means, but generally it is believed that they are only affected by high concentrations of the chemicals. Rumen microorganisms however, may be affected at lower doses, thus possibly affecting the cow's growth and milk production. PCBs, HEP, DDT, and PCP were tested by in vitro fermentation measuring percent dry matter disappearance (%DMD) and gas production. Four concentrations (0, 10, 50, and 100 ppm) were studied for 24 and 48 hours of incubation. Samples were removed from 48 hour incubations to determine if the chlorinated hydrocarbons were metabolized during fermentation. The %DMD proved to be a reliable method to determine microbial activity in the presence of chemicals while gas production lacked precision. At all concentrations, PCBs, HEP, and DDT had a %DMD of approximately 50 and 80 at 24 and 48 hours, respectively. PCP significantly ($P > .05$) depressed %DMD in 50 and 100 ppm cultures; with 45 and 30 at 24 hours, and 70 and 50 at 48 hours, respectively. Important metabolic changes in the test chemicals were not detected by gas chromatographic analysis. Cattle would need to consume large quantities of these hydrocarbons to achieve the high concentrations that were tested in vitro. Typical environmental contamination would not adversely affect rumen microorganisms.

*First Award - American Veterinary Medical Association
Second Award - ISEF/Environmental Sciences

CHLORAMINE T CAUSES DIURESIS AND NATRIURESIS IN THE RAT KIDNEY

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Chloramine T is a widely used oxidant present in many drinking water systems across the United States. Chloramines have several documented effects on biological systems. However, the direct effect of chloramine adjuncts on the inner mitochondrial membrane electron transport system has not been previously investigated. Mitochondria were isolated by differential centrifugation and chloramine T was added directly to the monometer flasks in concentrations from 0.005mM to 0.5mM. Oxygen consumption was calculated from the difference in the monometer readings times the flask constants giving uL of oxygen consumed. The data clearly show that chloramine T, at a concentration of 0.05mM, definitely has an effect and it becomes greater with the higher concentrations.

The in vivo study was conducted to determine the afore mentioned effects on the entire rat kidney. Male Sprague-Dawley rats were kept in metabolic cages and fed a diet of Purina lab food and were kept on a 12 hour light/dark cycle in a controlled environment. The experimental group was given chloramine T in their water in concentrations of 100mg/L. The water clearance by the kidneys of the experimental group was greatly reduced, while water intake increased. The concentraion of NH_4^+ for the experimental group was less than that of the control. The data also show that there was increased urea output in the experimental group. The data clearly show that the chloramine T causes diuresis and natriuresis in the rat kidney.

THE USE OF EFFLUENT FROM WASTEWATER TREATMENT PLANTS AS SOLUTIONS FOR THE REGENERATION OF MANGROVE FORESTS, FERTILIZATION OF GRASS, AND THE LOWERING OF EUTROPHICATION OF WATER BODIES.

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The discharge of effluents from wastewater treatment plants constitutes one of the major environmental problems in Puerto Rico.

The first phase of this project consists of the application of this type of effluent to a mangrove forest to evaluate the filtering capabilites of the system. It was discovered that this could help in the reduction of nutrients from the water. The second phase confirmed that the mangrove vegetation incorporates a great part of these nutrients in its tissues which help in the growing and regeneration of the system.

The third phase consisted in the evaluation of this effluent as a fertilizer when applied to a grassfield for landscaping. If the hypothesis that the nutrients in wastewater effluent serve in the fertilizing of grass is valid, then their application to this area will create a reduction in the cost of commercial fertilizer.

Four quadrats were planted with grass. Two of them, the controlled quadrats, received commercial fertilizer and tap water respectively. One of the experimental quadrat received only effluent while the other received in addition half of the fertilizer that was applied to the controlled quadrat.

The analysis of the foliar tissue found that the amount of nutrients was greater in the controlled quadrat with fertilizer, and in the experimental quadrat with effluents and part of the fertilizer, than in the other quadrats. Besides this point, the growth was greater in both quadrats and the color was more outstanding. On the other hand, there were not valuable changes observed in the soil's pH in any of the quadrats. On the basis of these results, it was concluded that the hypothesis is corroborated.

USE OF H_2O_2 TO INCREASE THE SUSCEPTIBILITY OF LIGNOCELLULOSIC MATERIALS TO MICROBIAL DEGRADATION

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My project is about the use of Hydrogen Peroxide and other chemicals to break down the cellulose in the cell walls of fiberous plant material. I used 4 types of lignocellulosic materials: corn cobs, corn stalks, oat straw, and Legume hay. I soaked the lignocellulosic material in six different solutions: Ammonia, 35% Hydrogen peroxide, 3% Hydrogen peroxide Sodium hydroxide, 20 volume Hydrogen peroxide, and water for a control.

I placed all of the samples in quart jars and soaked them completely for 24 hours.

In experiment 1, I did 15 experiments using the 3% Hydrogen peroxide.

In experiment 2, I did 3 experiments using 35% Hydrogen peroxide. These samples were burnt at the Noble Foundation during the drying process.

In experiment 3, I did 5 experiments with the Legume hay, Ammonia, Sodium hydroxide, 3% Hydrogen peroxide, 20 volume Hydrogen peroxide, and water.

I sent the sample to the Noble Foundation for analysis and plotted the results they sent back.

Next year, I plan on continuing this project, with the majority of the experiments being done with 35% Hydrogen peroxide. I plan on doing this, this summer, when the materials will be plentiful. This project has merit, and could be a big plus for the farmers as well as ranchers.

EFFECTS OF PHOSPHATE AND NON-PHOSPHATE DETERGENT ON DESMID REPRODUCTION.

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Three desmids--*Closterium*, *Micrasterias*, and *Pediastrum*--in two media, Alga-gro and Chu no. 10, were used to determine if phosphate detergents stimulated and non-phosphate detergents inhibited desmid reproduction. There were eighteen test groups which were cultured in 250-milliliter Erlenmeyer flasks for ten weeks. Data was taken weekly using field of view counts. To reduce experimental error, three slides were made; five field of view counts were taken on each slide. The cultures were swirled and samples were drawn from the middle. Cultures were rotated daily. In the final week, spectrophotometer and pH readings were taken. The same concentration of phosphate and non-phosphate detergents was used. Growth results from the field of view counts were: *Pediastrum* grew the most; *Closterium* was next; and *Micrasterias* grew the least. The Mann-Whitney U statistical analysis showed that the phosphate detergent did not and the non-phosphate detergent did stimulate desmid growth. Difference in medium did not affect desmid growth in the control groups. In the experimental groups, *Pediastrum* and *Micrasterias* were stimulated in Alga-gro and *Pediastrum* and *Closterium* were stimulated in Chu no. 10. Desmids absorbed more light at 400 and 690 nanometers as shown by the spectrophotometer readings. As desmid growth increased Ph of the cultures increased.

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*EXPERIMENTAL METHODS OF DETOXIFYING ORGANIC CHEMICAL WASTES USING PROKARYOTIC AND EUKARYOTIC CELLS AS INDICATORS

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The purpose of this project was to develop a method for the detoxification of organic chemicals that man puts into the aquatic environment. I used prokaryotic and eukaryotic cells as indicators of the degree of detoxification. The two toxins tested were 2,4-D and dichlorobenzene. For a period of 12 hours, the chemicals were subjected to different combinations of water and glucose while being irradiated with UV light and saturated with hydrogen or air. Both organisms E. coli (prokaryotic) and Candida Albicans (eukaryotic) were exposed to the EPA standards of the treated toxins. To determine if detoxification had occurred, I introduced the antibiotics streptomycin and tetracycline to the prokaryotic cell, E. coli. Nystatin was used on the eukaryotic cell, Candida albicans. Antibiotics were applied before and after the cells were exposed to the toxins. A change in the resistance or susceptibility of the organism to the antibiotic was used as an indicator for determining the degree of detoxification. The most effective tests in detoxifying both chemicals were combinations of hydrogen or air bubbled through the toxin in the presence of UV light, 3% water, and 20-30% glucose. However, detoxification of the chemicals was only moderately effective when the 3% water was removed. The remaining combinations of the five variables showed at least some degree of detoxification. In general, the degree of detoxification was not effected by either the test organisms, the antibiotics, or a single or double exposure.

*Second Award - Federal Aviation Administration
Third Award - ISEF/Environmental Sciences

IN SEARCH OF BEACH PRESERVATION YEAR 3

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The ultimate objective of beach preservation by controlling erosion involves a long-term investigation of the many facets of this complex subject. As a logical extension of my previous work based on wave power being proportional to the wave height squared and the conclusion that properly located and designed structures do reduce beach erosion, I have concentrated on the relationship between grain size, wave power and beach slope. I also analyzed the relationship of wave power and sorting of heterogenous sediment mixtures. In ths program, I applied four wave powers to beaches made up of homogenous sediments of four different grain sizes. All four sands were mixed and the heterogenous mixture was tested under the same conditions. The tests were repeated with the most successful energy absorbant structure from my previous years work, reconfirming my previous conclusion with regard to structures. All tests were conducted keeping testing time, wave powers, water depth, sediment quantity and initial beach slopes as constants. After each test, the resultant beach slopes were calculated, measured and compared with each other.

The results lead me to believe that the larger the grain size, the steeper the beach slope. However, higher wave powers do not necessarily reduce beach slope in proportion to their wave energy. The heterogenous material reacted differently to its component parts. I also observed that materials with distinct physical characteristics react differently under saturated conditions. This is one of the areas that I clearly need to investigate in my ongoing research into beach preservation.

#Second Award - ISEF/Environmental Sciences

MATHEMATICS

PATTERNS IN CHAOS

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The aim of this project is to study the evolution of systems that exhibit chaotic behavior, namely systems that seem to be subject to no law or that are not necessarily uniform.

A mathematical model of chaotic behavior is studied using a digital computer. This model consists of using a numerical method to find the roots of a non-linear algebraic equation. It is concluded that: 1) Chaotic behavior is characterized by the fact that very close initial conditions may lead to different roots of the equation; 2) Successive approximations from initial guesses leading to the same solution may follow very different "trajectories". The computer graphic solutions show, using magnification factors, the fractal nature of the boundaries between different solutions.

A water wheel, is used to study a physical system that has a complex chaotic behavior. A new effect has been discovered in this study, which was called the "roulette" effect. An effect described by Lorenz, which is here called the "kickback" effect is less important in the present device. Using a graphic analysis, a similarity is drawn between the two models, yielding unity to the concept of chaos.

THE DIOPHANTINE EQUATION $x^2=4q^n-4q+1$

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The purpose of this project was to solve the diophantine equation $x^2=4q^n-4q+1$, where q is any odd prime number. These solutions have not previously been determined. This problem is a generalization of one proposed by the Indian mathematician S. Ramanujan in 1913. His problem was to determine all integer solutions to $x^2=2^n-7$. This case occurs when q=2.

In this project, all solutions to the title equation are determined. Most importantly, it is shown that for q greater than 5 there exist no solutions with n greater than 2. This is done by working in the ring of integers of the algebraic field $\mathbf{Q}((1-4q)^{1/2})$ using the unique decomposition of ideals to reduce the problem to determining when a 1 appears in certain binary linear recurrences. At this point, using some ideas from linear recurrence theory and algebraic congruences, all solutions are determined.

#Scholarship - U.S. Navy
First Award - American Mathematical Society
First Award - ISEF/Mathematics
First Award - Mathematical Association of America
First Award - U.S. Army
Alternate to London International Youth Science Fortnight Trip - U.S. Army

THREE-VARIABLE INTEGRAL CALCULUS:NUMERICAL & GRAPHICAL ANALYSIS

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Analysis of three-variable functions, both from a graphical and numerical aspect, often presents a much greater problem to students of mathematics, than does the analysis of two-variable functions. The evaluation of single integrals, for example, involves less difficulty than does the evaluation of double integrals. Similarly, curve-sketching for two-variable functions may be accomplished by following a strict set of rules including both first and second derivative tests. The graphing of three-variable planes, however, poses a much greater problem. Few, if any, guidelines to graphing these planes may be found in calculus texts currently in use by many universities and colleges. Thus, the question becomes: Can the mathematics of three-variable functions be simplified by relating these to the mathematics of two-variable functions? Through writing complex computer software, I have been able to study the behavior of both two-and three-variable functions and their relationships. Using my computer program, I observed hundreds of functions and through this observation, I was able to develop rules, which, by utilizing knowledge of two-variable functions, allow for better visualization and easier understanding of the behavior of three-variable functions. These rules should prove beneficial to both novices and professional mathematicians in their quest for better understanding to the workings of three-variable functions.

#Alternate - Society of Exploration Geophysicists Trip

NEW METHOD FOR THE OBTAINMENT OF A FACTORIAL NUMBER

Miguel Angel Sosa Cosme
Francisco Zayas Santana
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This project was aimed to design a new method for the development of a factorial number where rows of negative numbers are obtained. My goal was to extend the theory of factorial number and at the save time develop an inverse procedure based on the data obtained. The purpose in this research project is to derive a formula related to the row obtained and express it by the use of summation notation form. Other necessary details are specified within the project itself.

Newton's Method: A Fractal Partition of the Complex Plane

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As introduced in The Beauty of Fractals by Pietgen and Richter, feedback functions of the m mth roots of unity have unique properties. Access to 19 digit accuracy in computer research allows an in depth study of these characteristics. A focal point is the generalization of Newton's Method for approximating the zeroes of a function on the complex plane according to DeMoivre's formula for the m mth roots of unity and its implications. Newton's method may be generalized and the graphic results of this feedback function have fractal boundaries between the basins of attraction generated by the roots of unity.

After iteration, most seeds converge to one of the m mth roots of unity. The number of iterations before a seed point's convergence hinges on a discernable pattern. Investigation reveals that a chaotic pattern of convergence exists near border points.

The Kent Series

Karen Kent
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The purpose of this project is to produce types of modular series, chart various relationships, and determine patterns between moduli and between types of series. The hypothesis is that if enough series are created, patterns will occur. To create the series, various computer programs were written. BASIC was chosen over other languages due to its availability. Apple, TRS-80, and IBM computers were used.

The Kent series are variations of the Fibonacci and Sidney series. The Sidney series and the Kent series are created by adding or multiplying numbers using different moduli to create repeating series. Different types of series include the Kent addition series, the Kent multiplication series, the Kent prime inclusive series, the Kent prime exclusive series, the Kent composite inclusive series, and the Kent composite exclusive series.

Most of the patterns have been found in the Kent prime inclusive series. They relate to the number of series of length X for a range of moduli. Many lengths occur in a regular pattern with no irregularities over 150 moduli. A preliminary analysis of other types of series shows that some patterns may be widespread. However, more time will be needed for a thorough analyzation.

FIBONACCI-GENERALIZED

Allison Hughes
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The Fibonacci sequence is a recursion sequence denoted f_1, f_2, f_3, f_4...where $f_1=f_2=1$. The sequence is derived from the formula $f_{n+1} = f_n + f_{n-1}$. I analyzed the generalization of this formula in which the first and second numbers in each sequence were arbitrarily selected. The sequence of terms derived is $x_1,x_2,x_3,x_4...x_n$ in which $x_1 = b$, $x_2 = a$, and $x_{n+1} = x_n + x_{n-1}$, for $n \geq 1$. Each sequence is denoted as $S(a,b)$.

Two such sequences with terms u_n and v_n are similar if they are "eventually identical", that is if some k and l and all r hold for $u_{k+r} = v_{l+k}$. Five theorems relating to the similarity of sequences were derived and proven by mathematical induction.

The relationship of these sequences to the Fibonacci sequence was studied. In particular, I discovered and proved that the nth term in any one of these sequences can be calculated in terms of Fibonacci numbers. The formula is $u_n = af_{n-1} + bf_{n-2}$.

I observed the limit of the ratio of two successive terms in any such sequence is always the same. The limit results in the golden ratio, which has received a great deal of attention in architecture, art, nature, and even the stock market.

I also derived formulas for these sequences analogous to known formulas for the Fibonacci sequence, and proved them through mathematical induction.

#Third Award - American Mathematical Society
Third Award - ISEF/Mathematics

USE OF MATHEMATICS IN COMPUTER TO DETECT AND CORRECT ERROR

ORTIZ TORRES, RAMON J.
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With the increase in use of electronical equipment such as computers, the need for a rapid means of sending information has also risen. For this reason computers are being used to send messages. These messages are sent in binary system, composed of 0's an 1's.

But this system is short of perfection due to a basic problem, external signals which alter the message, since during its transmission by a computer and reception by the other, their signals alter the whole message. For this reason it's divided into groups and the groups generally are composed of 100 digits or more; where only some groups are alternate in some digits, resulting very expensive, in having to send the message again. Due to this it's divided into groups of 7 digits, since the percentage of error in 2 digits within a group is lower than 0.001%.

By means of mathematical formulas a computer program will be prepared that will receive the message in binary code, will verify it, and if an error exists will correct it. The Hammin correction system will be used to detect errors.

Once detected, the error will be multiplied by a matrix to find in which digits the error exists. Then the error vector, which is a series of zeros except where the errors located, will be subtracted in order to correct the message.

#First Award - U.S. Air Force

STRATEGIES OF ATTACK: AN UNSOLVED PROBLEM

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The purpose of this investigation was to develop new ways of approach to a major unsolved mathematical problem—What is the probability that when N points are chosen at random in a cube, no two of them will be closer than a prescribed distance?

Several strategies were developed and employed to approach the problem. Restriction and limitation of the problem, graphical representation, geometric probability theory, and use of a computer to obtain empirical data were among the methods used to help in the solution of the problem.

The one-dimensional problem for all conditions and the two-dimensional problem for one fixed point were solved and the solutions proven by geometric probability theory. Approximations of the solutions for the other problems were derived from the empirical data. Significant progress was also made towards proofs for the remaining unsolved problems.

This is an important unsolved problem in statistical mechanics. Its solution would shed much light on the theory of changes in state of matter and the interaction between particles, on very small to very large scales.

# BLASIAK'S METHOD OF EVALUATING DETERMINANTS

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PURPOSE: To develop a new method of solving determinants of the third order and greater.

PROCEDURE: A determinant of the Nth order has been found to be equal to a 2x2 determinant of determinants of the N-1 order, which are formed by deleting one of the outer rows and columns from the original matrix, and divided by the middle determinant of the N-2 order, which is obtained by removing both the first and final rows and columns from the initial determinant. A problem arises when the middle determinant has a value of zero, since it is undefined to divide by zero. This problem can be averted by rearranging the rows (or columns) in such a way so that the expansion of the middle determinant is nonzero and multiplying by a scalar quantity of negative one to the power of the number of rearrangements between any two rows (or columns). This procedure follows one of the basic properties of determinants, which states that if two rows (or columns) of a square matrix are interchanged, the sign of the determinant is changed.

CONCLUSION: By means of algebraic proofs, the proposition has been proven valid. Using it in actual applications, the method is a practical way of evaluating determinants.

#Fourth Award - ISEF/Mathematics
Honorable Mention - National Aeronautics and Space Administration

# DEVELOPMENT AND APPLICATION OF CHAOTIC TECHNIQUES FOR THE ANALYSIS OF MULTI-DIFFERENTIAL SYSTEMS

Scheirer, Eric; Thomas Jefferson H.S. for Science and Technology,
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This project deals with the three-differential planar circular restricted problem, an example of a non-linear dynamical system.
The planar circular restricted problem is a classic astronomical problem involving the characterization of the motion of a planet about a binary star. Only in recent years has any systematic study of these complex systems been possible, for "traditional" mathematics is unable to solve the problem. This project makes use of a new branch of theoretical mathematics, chaos theory, to describe ways in which non-linear systems can be probabilistically modeled using high-speed computers and simulation techniques.
As the analysis of the PCR problem using "traditional" math is not feasible, I have developed new techniques which can describe with great accuracy the relationships between various parameters of the problem and its solution, the orbit of the planet. These techniques can be combined with Bayesian methods and the Fourier transform to give a very complete view of the problem's solution in a probabilistic sense.
The PCR problem is only a single example of a non-linear system which can be modeled and analyzed in this manner. The techniques developed can also be generalized to the analysis of many other sorts of dynamical systems, such as weather prediction, fluid dynamics, and electrical many-body problems. The development and application of chaotic techniques for the analysis of multi-differential systems is a very important area, and one which has been barely touched upon.

#First Award - National Aeronautics and Space Administration
Fourth Award - ISEF/Mathematics

# WILL NEWTON'S METHOD WORK ON THE COMPLEX PLANE?

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Newton's method of successive approximation is a means of arriving at a solution of an equation from any arbitrarily chosen point.
Before attempting to apply Newton's method to the complex plane, it was first studied on the real plane. To do this, we considered the equation $X^2-1=0$, which has two real roots to which Newton's method will converge. The graphs drawn with the aid of a computer program, show two distinct regions of convergence; one region approaches the solution 1,0 and the other approaches -1,0. These two regions are separated by a distinct, clearly demarcated boundary. In the complex plane the equation $X^3-1=0$ was studied. This equation has three roots, two of which are complex (-0.5,0.866i and -0.5,0.866i), and one which is real (1,0). The boundaries between the three areas of convergence are not as clear as they are on the real plane. Using the computer to graph the results, the boundaries appear very irregular.
To examine the transition between the distinct boundaries of the real plane and the irregular boundaries of the complex plane, the equation $CX^3+(1-C)X^2-1=0$ was analyzed at values of C between 0 (at which $CX^3+(1-C)X^2-1$ is equivalent to X^2-1) and 1 (at which $CX^3+(1-C)X^2-1$ is equivalent to X^3-1). Irregularity is observed at a value of C as small as 0.01 and the degree of irregularity increases as C increases.

#Fourth Award - ISEF/Mathematics

FRACTALS: THE JULIA SETS

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In this project, I attempted to discover additional insight into the way in which the Mandelbrot set predicts the general shape of Julia Sets, when one plugs a value of "c" into the sequence:

$$\{X_{n+1} = (X_n)^2 + c\}$$

"c", determines the shape of the Julia set one gets when one iterates the sequence, and graphs the behavior of the terms of the sequence on the complex plane.

I wrote a program that takes a certain value of "c", plugs it into the sequence, and graphs the Julia set for that particular value of "c". My hypothesis postulated that as one substitutes in values of "c" that are further and further away from the origin, the appearance of the Julia sets would become more fragmented, and less like the circle that one gets when zero is used for "c".

It was discovered from research that certain areas of Mandelbrot set produce specific behaviors in the corresponding Julia sets. My data correlated highly with the hypothesized results. I also discovered that my hypothesis needed to be qualified, due to the asymmetry of the Mendelbrot set. It needed to be specified that as values of "c" increase along a vector, they would become more fragmented and less circle like, and not just as values "c" increase in general.

MATHEMATICAL OPTIMIZATION OF SCHOOL DISTRICT BOUNDARIES

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This project began with the simple belief that there had to be a logical method to optimize school district boundaries. Since Brown vs Board of Education, school districts have struggled to provide quality integrated schools and in this county the levels of integration have steadily declined.

The goal of this project was to design a definitive algorithm to objectively distribute the 553 Student Area Codes (SACs) that cover the county. The algorithm would balance three criteria: optimize each school's racial balance along county guidelines; retain continuity between the SACs within a school district; and minimize transportation distance for students.

The algorithm progressed through several major levels of design before it was tested using combinations of three sorting methods for minimizing travel distance, two which maximized continuity, and a routine for achieving optimum racial balance. The algorithm set up several variations with average racial deviations far below that of the current school conditions. Maximum travel distance was maintained and continuity of school boundaries improved with each test.

Further experimentation focused on the placement of projected schools. The algorithm was used to analyze the impact of schools under construction and yielded valuable results.

What began as a simple idea required over 300 hours to execute. The concluding algorithm successfully met all of the design criteria: it improved racial balance, encouraged continuity, and minimized travel distance.

#First Award - Sigma Xi, The Scientific Research Society
Third Award - American Mathematical Society
Third Award - ISEF/Mathematics

AN ANALYSIS OF PATTERNS OCCURING IN THE DIGITAL SUMS OF NUMBERS RAISED TO CONSECUTIVELY GREATER POWERS IN DIFFERENT BASES

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A number of patterns are apparent in the digital sums of numbers raised to consecutively greater powers in different bases. This project deals with the discovery and analysis of these patterns. A few of the more interesting patterns are described below.

When a number is raised to consecutively greater powers in any base, a repetitive sequence will form in the respective digital sums. This repetitive sequence will be identical for those numbers which are congruent modulo the base minus one.

Many patterns are apparent among those sequences which have more than two terms and have the original number itself repeated in the sequence. For every such sequence, there will be another sequence whose terms are in the reversed order and whose first term is the next to the last term in the original sequence. For each of these pairs of sequences, there will be another pair at an equal distance from one-half the number, the base minus one.

THREE DIMENSIONAL PASCAL TRIANGLE AND TRINOMIAL THEOREM

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This project involves the derivation of a formula for the Pascal Triangle in three dimensional space and a formula for the expansion of $(x+y+z)^n$.

The basic principle of the Three Dimensional Pascal Triangle formula is based upon the basic principle of the Pascal Triangle, and derived by finding the sequence of the values of the points.

I derived the formula for the Trinomial Theorem from the Binomial Theorem by expanding $(x+y+z)^n$, and by taking the sequence for the results and translating its coefficients into the formula of the Three Dimensional Pascal Triangle. Using Mathematical Induction, I have also proven the validity of the Trinomial Theorem.

As a result, we have a formula for the Three Dimensional Pascal Triangle and a formula for the expansion of $(x+y+z)^n$.

NEW THEORY OF REMAINDERS GENERATED BY THE FORM ABC

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Using the square number from 100 (one hundred) on, their square roots are divided by the first digits, eliminating the last digit; ab divided by the square root of abc. Once this is done, a pattern of remainders reflexing three different progressions from each group of ten are obtained. This pattern can be use to predict how many remainders can be obtained from each group. Also by another mathematical procedure it is possible to obtain the original number starting with the remainder. Other details are specified within the project itself.

* INVERTED CONTINUED FRACTIONS: A NEW REPRESENTATION OF THE REAL NUMBERS

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If we switch the 1's and the a_i's in the ordinary continued fraction $a_1 + \frac{1}{a_2+} \cdots + \frac{1}{a_n} = [a_1, \ldots, a_n]$, we get $1 + \frac{a_1}{1+}\frac{a_2}{1+} \cdots + \frac{a_{n-1}}{1+a_n}$, a result I'll call an inverted continued fraction and I'll denote by $[a_1, \ldots, a_n]^*$. No study of such fractions appears in the literature.

The development of a rigorous theory of inverted continued fractions and the proof that every real number can be expressed (though not uniquely) as a simple inverted continued fraction are the major objectives achieved in this paper. I determine conditions under which an infinite inverted continued fraction converges to a real number. I develop a method for expressing every real number as a simple inverted continued fraction, and I prove that the resulting fraction is rational if and only if it has an infinite tail of 2's.

All simple ordinary continued fractions converge, so we don't study their convergence; but infinitely many simple inverted continued fractions diverge, so their convergence is studied in detail. Necessary and sufficient conditions for divergence are established. An unresolved question is whether, for all simple inverted continued fractions $x = [a_1', \ldots]^*$, there is a "comparison test" function $f(n) = a_n$ so that if, for all n, $a_n' \le a_n$, then x converges and if, for all n, $a_n' > a_n$, then x diverges. I establish that such a function must be asymptotically equal to n^2, and I prove that $\lim_{n\to\infty} [1, 4, \ldots, n^2]^* = \log_2 e$.

*First Award - ISEF/Mathematics
First Award - U.S. Navy
Second Award - American Mathematical Society
Second Award - Mathematical Association of America
Alternate to American Committee for the Weizmann Institute of Science

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MULTIPLIER RECODING IN COMPARISON TO ITS BINARY EQUIVALENT

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Today's computer numbering system uses 1's and 0's, and its arithmetic operations uses 1's and 0's. To speed up certain arithmetic operations, such as multiplication, I recoded the multiplier into three-state digits (0, 1 and $\bar{1}$*).*

It is commonly accepted that instead of multiplying a decimal number by 9999, it is easier to multiply that number by 10000 (just adding four 0's) and then subtracting that number. Seeking a similar approach for binary numbers, I developed a scheme to recode the binary multipliers.

The recoded multipliers have the same value as the original multipliers and they can save many steps in the multiplication process. It is also shown that as the number of digits in the multiplier increases, the average number of steps saved, when using the recoded multiplication scheme, increases directly.

#Second Award - ISEF/Mathematics

* UNITARY HALF PERFECT NUMBERS

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$\varphi^*(n)$ is the unitary analogue of a famous number theoretic function $\varphi(n)$. $\varphi^*(n)$ is defined to be the number of positive integers less than or equal to n which is relatively unitary prime to n. The value of $\varphi^*(n)$ is given by the product of (unitary prime power divisors of n -1). This project investigates the properties of the unitary half perfect number which is defined to be a positive integer of which the value of $\varphi^*(n)$ is a half of n. 12 is a unitary half perfect number since $\varphi^*(12)=\varphi^*(4\cdot 3)=(4-1)(3-1)=3\cdot 2=6=\frac{1}{2}\cdot 12$. It is shown that all unitary half perfect numbers are even and 2 is the only unitary half perfect number which is a power of 2. Some properties of unitary half perfect numbers are proven and using the properties, the upper and the lower bounds for the fraction $n/\varphi^*(n)$, where n belongs to a fixed class of positive integers, is derived. The upper and the lower bounds help finding whether there exists a unitary half perfect number in a fixed class of positive integers. Therefore, one can find a unitary half perfect number with a fixed number of distinct odd prime factors or a fixed number of the power of 2. 2, 12, 168, 240, 14880, and 65280 are the only unitary half perfect numbers less than 3924480.

*Third Award - American Mathematical Society

*PASCAL'S POLYTOPE: AN INVESTIGATION OF GENERATION PROPERTIES IN "N" DIMENSIONS WITH APPLICATIONS TO THE EXPANSION OF $(\Sigma_i^N T_i)^m$

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Historically, Pascal's Triangle was developed as a tool to be used in probability theory. It was later determined that applications in the areas of combinatorics and expansion of binomials existed. Much research has been conducted in relation to a three dimensional Pascal Pyramid. The purpose of this research is to:

I. To develop a Pascal Hyperpyramid.
II. To perform and study variations placed upon Pascal's Triangle.
III. To develop a formula for the specification of terms in three and four dimensional Pascal Polytopes.
IV. To apply these formulas to develop a method to determine the coefficients of a specific term in the expansion of trinomials and quadrinomials, and to eventually include polynomials.

To accomplish these goals, previous investigations related to figurate numbers were used to develop the four dimensional Pascal Polytope. Excercises concerning variations of Pascal's Triangle were conducted to provide insights necessary to complete the most critical part of the research, namely the development of the formulas for specific terms in three and four dimensional Pascal Polytopes. These formulas were proved by use of triple and quadruple proofs by mathematical induction. These newly-developed formulas were then applied to the problem of computing the coefficients of specific terms in the expansion of $(A + B + C)^M$ and $(A + B + C + D)^M$. Through further research and by means of a Proof using the Principle of Complete Induction, a formula (pattern) for the general Nth dimension was derived.

*Third Award - ISEF/Mathematics

SINUSOIDAL REFLECTIONS

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Hypothesis: There are some formulae for defining points on a Cartesian Plane that have been mathematically reflected through a sinusoid, and some formulae for defining a ray or line (in conjunction with a Cartesian Plane system) that have been physically reflected by a sinusoid.

Development: A long development process utilizing algebra, geometry, trigonometry, and calculus resulted in the following formulas.

Any point (p,q) reflected through any line $(y = m(x-a) + b)$ results in the point:

$$\left(2\left[\frac{m^2a + m(q-b) + p}{m^2 + 1}\right] - p,\quad 2\left[\frac{p}{m} + q - \frac{m^2a + m(q-b) + p}{m(m^2 + 1)}\right] - q\right).$$

Any point (p,q) reflected through any sinusoid $y = A\sin B(x-C) + D$ results in the point: $(p, 2[A\sin B(x-C) + D] - q)$.

An incident ray $(x = c)$ striking the sinusoid $y = \sin x$ perpendicular to the sinusoidal axis will physically reflect to the new ray

$$y = \tan[-2\mathrm{Arctan}(-\frac{1}{\cos c}]\ (x-c) + \sin c.$$

Conclusion: These formulae prove the hypothesis to be correct and give rise to an area of mathematics which has not as yet been explored to such an extent.

A STUDY OF P_t-SETS

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Consider the set of integers (1,3,8,120). Fermat is said to have been the first to recognize that this group of numbers possesses the property such that the product of any two terms increased by 1 results in a perfect square. In recent times there has been a growing interest in similar sets of numbers, called P_t-sets, where t, the index, is the number added to the products. These differ from those studied in the past in that there is no restriction on either the number of terms in a set or the value of the index.

In this project the student began his own investigation of such sets' properties and how they can be affected by different variations. The student studied and developed formulae for sets deriving from Fibonacci, Lucas, arithmetic, and geometric sequences. He also briefly worked with sets containing negative numbers. The student found the first ever odd type P_t-sets, sets in which the sum of the terms is an odd number, and with them, developed a simple method by which two different index values can be obtained for certain groups. In addition attempts were made to discover a size five P_t-set. The student greatly relied on the use of his own and his school's computers to search and obtain vast amounts of data. Overall, the student feels that he made considerable progress in the study of P_t-sets and that his findings will be crucial to the future developments in the topic.

#Second Award - ISEF/Mathematics
Third Award - American Mathematical Society

THE SPIRAL SEQUENCE

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My research project is to determine results within a spiral sequence. Two major problems were solved. One was to be able to find where any number is in the spiral sequence when given the coordinates of the number. The other was to find the coordinates when I was given a number.

I divided the spiral into eight different sequences which had second degree formulas. From this I found the formulas for all eight directions, coordinate axes and main diagonals. Two algorithms were developed to solve the problems posed. Quadrants, half-planes, rotated quadrants and rotated half-planes of values were determined. The final solutions were found by relating them to the eight sequences. Additional cases were studied such as changing the sense (clockwise vs. counterclockwise), placement of numbers, and altering the generating sequence (evens and odds).

This project has now given me some interesting ideas. The sequence can be applied to models of DNA helix, staircases, library book storage, road construction, three-dimensional figures, and other uses. I am also working on changing the project in such a way that I can make each sequence into its own spiral. This can also help me to formulate patterns for other spirals of numbers such as arithmetic sequences, geometric sequences, alternating sequences, Fibonacci-related sequence, as well as others.

THE EFFECTS OF COMPUTER TRADING ON THE STOCK MARKET

A MONTE CARLO SIMULATION

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On Monday, October 19, 1987, the Dow Jones Index experienced its second major crash in Stock Market history. On Black Monday, the Dow fell 508 points. There have been a number of speculations why the Stock Market crashed. Several experts agree that the practice of computer trading might be linked to the crash. The purpose of this project was to explore the influence of computer trading on the Stock Market. Of particular interest is the potential connection between computer trading and crashes.

1. First I analyzed the Dow Jones Index for 1985 and 1986 in regard to its statistical properties: removal of running mean, distribution of remaining residuals, and probabilities for consecutive day events.
2. In part two of the project I wrote a Monte Carlo simulation of the Dow Jones Index which closely mimics the actual performance of the real index in a statistical sense. This simulation includes short term trends over a few days.
3. In the last part of the project I simulated the effect of computer trading on the Dow Jones Index.

I succeeded to show that computer trading can significantly enhance the likelihood for major crashes. This likelihood is dramatically influenced by the critical five day percentage loss, which triggers selling. Careful review of the 1985, 1986, 1987 Dow Jones Index records showed that the experimentally determined probabilities for crashes were realistic. To avoid major crashes, computer trading should not be linked to global stock indeces. It should be limited to the performance of individual stocks only.

Reflections Through Curves

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Is it possible to generalize mathematically the notion that a mirror must be flat? My answer is yes. Let us represent a general mirror by a curve Γ. Point (A,B) has a reflection through point (x,y) on Γ whenever a line segment from (A,B) to (x,y) is perpendicular to the tangent to Γ at (x,y). Clearly, (A,B) may have more than one reflection through Γ. Using this definition I explore the properties of reflections through curves. I derive a general formula for the reflection of a curve through a curve.

#Second Award - U.S. Air Force
Third Award - Mathematical Association of America

A GENERALIZATION OF "3X + 1" PROBLEM

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The purpose of this project is to get new insigths into the unsolved "3X+1" problem. The problem itself is a conjecture about the behavior of some special function f definid, over all positive integers, by $f(x)=x/2$ when x is even and $f(x)=(3X+1)/2$ when x is odd. Beginning with an arbitrary number x, by succesive applications of f, a sequence is formed: x, f(x), f(f(x)), f(f(f(x)))),.... . The "3X+1" problem consists in proving that 1 always appears as a sequence element.

The problem was generalized by introducing a new f, (given an integer b, $f(x)=x/b$ when x is divisible by b and $f(x)=((b+1)x+c)/b$ otherwise; where c is equals to b minus the division residue of x by b). Special graphs were used to study the behavior of the sequence. Experimental results show that the new function's behavior is similar to the old one: there are some numbers that always appear in the sequence (not necessarilly 1).

The main proved results are: several classification of sequence points and bounds over monotonic growth of sequence values.

A-MORPHIC NUMBERS

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An a-morphic number is a natural number, which, when raised to the a^{th} power ends in the original number (in base ten notation). For example, 51 is 3-morphic as $\underline{51}^3 = 1236\underline{51}$ and 9376 is 2-morphic as $\underline{9376}^2 = 8790\underline{9376}$ The results of this paper show that if given an a-morphic number and the leading digit is removed, the resulting number is also a-morphic. For example, 9376, 376, 76, and 6 are all 2-morphic. From this, a family of order a is defined to be the set of all a-morphic numbers which share a common units digit. Therefore, $937\underline{6}$, $37\underline{6}$, $7\underline{6}$, and $\underline{6}$ are all in the same family of order 2. A method to calculate the next largest number, under certain conditions, is also discussed.

#Fourth Award - ISEF/Mathematics

IS THERE A MATHEMATICAL BASIS FOR THE BELL CURVE?

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This research and experiment demonstrates the mathematical/probability basis for the commonly used "bell curve". A peg board with slots was built. Marbles were rolled and results were recorded/graphed. The general mathematical formula for probability is: If EL is the number of times that something is Equally Likely to happen, and F is the number of times the results could be Favorable, then the formula for the Probability of Favorable results occurring is written: PF=F/EL. Mathematically, the probability of marbles falling into specific slots on the board can be easily understood if you follow one marble down the board. When it hits the first wooden peg, it can go only to the right or to the left. This means the numerical value of the probability that it will go to the left of the first wooden peg is 1/2 (the number of Favorable events possible divided by the number of Equally Likely Events). When the marble hits a peg in the second row, it now has two more possibilities: left or right but there are two pegs. Therefore, the numerical value for the probability the marble will be to the left of the left wooden peg in Row 2 is 1/4. Etc. There is one final observation which I cannot fully explain. For demonstration purposes, I wanted to draw a neat and readable chart showing the probabilities of each marble bounce. Simply for measurement, I used a set of compasses to get an exact 3 inch spacing. I saw that the intersection of the lines made a bell shaped depiction of the marble bouncing off of each peg. By then experimenting with a set of compasses and drawing 6 inch circles (3 inch radius), I realized that the arcs of the circles had a mathematical relationship to my entire project.

The Analysis of the "Snowflake Curve"

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The "Snowflake Curve" was first produced in 1904 by Helge Von Koch. His snowflake was created to challenge elite mathematicians of his time, and to explain certain sequence/series principles. My snowflake is a modernized version of Von Koch's. It could be used to interestingly and innovatively introduce sequences and series to a calculus/pre-calculus high school or college class. The snowflake has been computerized (using the Apple LOGO language) to visually demonstrate the snowflake's construction. This project cites an example of how the snowflake could be used in an everyday classroom.

The snowflake, itself, begins with an equilateral triangle with side length 1 unit and, hence, a perimeter of 3 units. Each of the three sides of the original triangle are trisected, the middle piece is removed, and a new equilateral triangle with side length 1/3 unit (the length of each trisected piece) is created where the omitted piece was. These new sides are then trisected, the middles are omitted and an equilateral triangle with side length 1/9 the original triangle is placed in the omitted space. The construction continues indefinitely for each new side and certain sequence/series patterns are formed involving side length, perimeter, and number of sides. One revelation of this project was while the perimeter increased indefinitely, the area of the snowflake remains within a finite space. This happens due to the laws of infinite geometric series.

# ECOSOFT - A MATHEMATICAL MODEL OF THE ECOSYSTEM

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Ecosoft is a computer based mathematical model which attempts to simulate ecological processes in a generalised system. The development of the model can be divided into four phases:

Firstly a field study of the ecological concepts of the Hastings Point region of eastern Australia. From this study a general flowchart for any ecosystem was developed which identified the interactions in the environment that would have to be considered in the proposed model.

The second phase involved deriving the mathematical equations which could simulate these interactions. Equations controlling the environment concerned four major factors: Sunlight, Temperature, Water Levels and Nutrients. 3 general functions were determined to govern organism population levels: the Alpha and Beta functions for environmental effects on plants and animals respectively, and the Phi function for Predation interactions.

Thirdly, these equations were integrated to form the General Model - a computer program which predicts the course of events in a given ecosystem. The General Model was tested, and then in phase 4 situations were investigated involving the effect of Man upon the environment. Factors such as Nutrient Loss, Poisons, Chemicals, and 'Nuclear Winter' were examined. Evolutionary processes were also researched.

The main result from the project was the actual creation of the General Model. Also, several useful application areas were outlined, as were many future research possibilities.

#Second Award - Sigma Xi, The Scientific Research Society
Fourth Award - ISEF/Mathematics

GRAPHING POLYGONS

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The concept of a two-dimensional graph as the limit of a two-variable equation was introduced. Using this concept, a square was graphed. The equation of the square was found to be $|y| = \lim_{n \to \infty} \sqrt[2n]{\frac{\sqrt{2}}{r} - x^{2n}}$, r being the radius. Next, a figure resembling a square with extended diagonals was derived from a modified form of the square's equation. Finally, this graph was "subtracted" from:

a) Two vertical lines to yield an irregular hexagon represented by the equation

$$|y| = \lim_{n \to \infty} \sqrt[2n+1]{(a-|x|)^{2n+1} - \frac{a}{2}} \quad ,$$

$|x| \leq \frac{a}{2}$, $|y| \leq a$, with a as the semi-major axis.

b) A square to give a regular octagon with the equation

$$|y| = \lim_{n \to \infty} \sqrt[2n+1]{\left(\frac{r\sqrt{4+2\sqrt{2}}}{2} - |x|\right)^{2n+1} \pm \frac{r(2-\sqrt{2})(\sqrt{4+2\sqrt{2}})}{4}}$$

$$\cup \quad |x| = \lim_{n \to \infty} \sqrt[2n+1]{\left(\frac{r\sqrt{4+2\sqrt{2}}}{2} - |y|\right)^{2n+1} \pm \frac{r(2-\sqrt{2})(\sqrt{4+2\sqrt{2}})}{4}},$$

$|x| \leq \frac{r\sqrt{2+2\sqrt{2}}}{2}$, $|y| \leq \frac{r\sqrt{2+2\sqrt{2}}}{2}$, with r again representing the figure's radius.

*

A TWO-YEAR INVESTIGATION OF REGULAR AND SEMI-REGULAR POLYHEDRONS AND THEIR CORRESPONDING FIGURATE NUMBERS

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The objective of the first year of study was to examine polyhedrons and polyhedral numbers through discovering any similarity between the general polygonal and polyhedral formulas.

The initial steps of research involved extensive research in books and periodicals, defining the necessary terms, stating the purpose, and creating tangible polyhedral models. The next step concerned proving that only five known regular polyhedrons exist. The main step involved taking the polygonal formula and deriving a general polyhedral formula: $T_N = N/6[AN^2 + [3(V-2) - 3A]N + [2A - 3(V-4)]]$. Any sequence term could now be determined. It was discovered that the polygonal formula is a special case of the polyhedral formula. A computer program was then designed to generate polyhedral numbers.

As a result of my research, a greater understanding of mathematical logic, induction, and formula derivation was obtained. The research tied together algebraic and geometric processes to achieve a formula for polyhedral numbers.

The purpose of the second year of study is to derive two individual formulas for the simple and complex semi-regular polyhedral numbers.

The first procedure involved thorough research of the semi-regular polyhedrons. Definitions and terms were discovered and formed. After the purpose and hypothesis were stated, models of both styrofoam and paper were made. Using data obtained from the thirteen shapes, two formulas were derived to generate the different types of numbers: $T_N = V + (N-2)E + T_{N-1} - M(N-2) + 1$ and $T_N = V + (N-2)E + (V * (T_{N-1} - M(N-2) + 1))$. The result, through computer application, was the use of the two formulas in generating semi-regular polyhedral numbers.

*Third Award - ISEF/Mathematics

SUMS OF SQUARES

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A sums-of-squares grid is constructed by placing the perfect squares on both axes, such that the elements of the grid are the sums of both corresponding squares. The pattern of a number is produced by placing dots at the location of the particular elements of the grid which are evenly divisible by that number. The repeated portions of some patterns (the pattern of n repeats after n rows and n columns) turn out to be facinating designs while others are uninteresting, with only a few dots. The purpose was to determine a working method to predict the number of dots in the pattern of any number.

The first step was to print patterns 1-50 using a homemade machine-language generator program. The E function value (number of divisible elements) in each of these patterns was then counted and compared to relevant information such as the numbers' prime factorization and congruence mod 4. This data, once compiled and examined, was used to formulate three conjectures. Conjecture #1, the simplest, was the method to determine the E of any prime number. It actually consisted of three formulas, one each for primes congruent to 1, 2, and 3 (mod 4). This was expanded to work for primes raised to any power in Conjecture #2, which was much more difficult to discover. Conjecture #3 was also difficult to observe, although it can be stated simply. The E of a number is the product of the E of each member of its prime factorization, if each member is defined as both the prime and its exponent. Using these conjectures, the numberof dots can be predicted for the pattern of any number, prime or composite.

PASCAL'S TRIANGLE: WITH AN ADDED DIMENSION

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Pascal's triangle is a set of numbers derived from the coefficients of the binomial expansion, $(a+b)^n$. This set of numbers contains many patterns which can be used in making predictions of probability. By taking the coefficients of a trinomial expansion, $(a+b+c)^n$, a third dimension is added, and the triangle becomes a pyramid. This pyramid-like system of numbers would contain three faces, each of which would be the system of numbers in the original triangle. Patterns of numbers should exist in the pyramid similar to the way they appear in the simple triangle. These patterns of terms could exist in any of the many directions of rows, columns, and diagonals of the pyramid. The patterns in the triangle taken to one higher degree, should have direct correlations with those that should appear in the pyramid. Given that patterns do exist within the pyramid, it could prove beneficial for making logical, probable predictions. These predictions would not be limited to the two-possible-predictions produced by the triangle, instead they would offer more detailed predictions, due to the added dimension.

RELATIONSHIPS AMONG THE PRIMITIVE INTEGRAL SOLUTIONS OF THE PYTHAGOREAN THEOREM

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The Pythagorean theorem is the basis for trigonometry and Euclidean geometries. It is one of the most versatile and heavily used theorems in mathematics. The primitive integral solutions of the Pythagorean theorem have many relationships among themselves and other number sequences. The solutions have an intimate connection with the theory of numbers, as evidenced by the solutions' associations with the primes, the twin primes, the transcendental functions, and the Fibonacci series. Knowledge of this series of solutions and its affiliations with other known sequences of numbers will provide new light on the future attempts of the proof of Fermat's Great Theorem and the possible derivation of relationships dealing with higher forms of Pythagorean-styled equations.

STUDY OF THE CARDINALITY PROPERTIES ON INFINITE SETS

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The problem to be investigate consists on discovering the cardinality properties of infinite sets, and then to put the rest of those sets in relation to the rest of the sets in the universe. To discover those properties, we have used the theorems and definitions regarding the modern theory of sets. The methodology consisted in using the funtional algebra and the "Theory of Real Variables" to associate each infinite set with a chosen set and, using the biyection, discover the cardinality properties of the treated set. The investigation showed that the infinite sets have two kind of cardinality: Aleph Zero and Aleph One. It has been concluded that Aleph One belongs to the Reals (R) and the Irrationals (I), and the denumerable sets as Naturals and Rationls belong to the Aleph Zero.

PROJECTIVE GEOMETRY: PHASE II, THE ELLIPSOID

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The purpose of this project is to explore the possibility of obtaining specific information about an unknown solid conic figure using its three coordinate planes. In this study, mathematical formulae for the calculation of Surface Area and Volume of an unknown ellipsoid were developed. Using a concentrated light source, the three perpendicular bisecting planes of the figure under observation were defined and, consequently, the major, minor, and mean axes were determined. The family of ellipsoids (figures generated by ellipses) includes spheres, spheroids, and ellipsoids. The data from the three coordinate planes satisfied the general equation of an ellipsoid. Double and triple integrals were used to derive equations for the Surface Area and Volume. These newly developed formulae were verified with the standard equations for the Surface Area and Volume of a sphere. The Surface Area and Volume of the figure were then calculated using data from its three axes. In conclusion, it is possible to obtain specific properties for an unknown solid conic figure using a concentrated wave source (light or sound) and previously derived formulae. It is not necessary to use physical measurement, and only two of the three coordinate planes are required for evaluation. This geometrical experiment has practical ramifications in the fields of space, engineering, optics, and medicine.

MEDICINE AND HEALTH

POSSIBLE RESIDUAL TERATOGENICITY OF ISOTRETINOIN

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Isotretinoin is a known teratogen when taken during the period of embryogenesis. Unlike vitamin A, isotretinoin is not stored in the liver. Isotretinoin is 99.9% bound to plasma proteins, in vitro. The drug readily crosses the placenta in animals. Isotretinoin has the ability to be in the blood for long periods of time. These characteristics question the recommendation that only one menstrual cycle should pass, after the discontinuance of the drug, before becoming pregnant. Tests were conducted on albino lab mice. Four groups of five female mice were separated. Two of the groups were used for control models. The other two groups were used to test the ability of isotretinoin to cause birth defects after discontinuance of the drug for one estrous cycle. The tests were conducted at different dose levels. The data gathered shows no birth defects are apparent when the drug is discontinued and one estrous cycle is allowed to pass before conception. Although there is a significant difference between the weights of the test groups.

REGULATION OF BASEMENT MEMBRANE SYNTHESIS: A FOUR YEAR STUDY

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Basement Membranes (BM) are extracellular filters found in renal blood vessel walls which keep blood proteins in the blood and allow waste products to enter the urine. Diabetic complications occur as a result of faulty BM components. Previous research determined the effects and stimulation of Newborn Calf Serum and five Cohn Fractions of this serum. This current research attempts further to fractionate, isolate, and identify the substances in Cohn Fraction IV (CF IV) and Cohn Fraction V (CF V) that stimulated the BM.

To perform these studies, CF IV and CF V were separated by DEAE Chromatography. BM Tumor tissue was isolated from black mice, and added to Newborn Calf Serum. The Cohn Fractions were made into three dilutions and also added to tumor tissue. BM cells were allowed to produce BM proteoglycans and proteins.

Newborn Calf Serum, CF IV, and CF V stimulated the BM. CF IV stimulated BM proteins ten times as effective as CF V, while CF V activated BM proteoglycans ten times as much as CF IV. SDS Gels recorded the separation of protein bands in CF IV and CF V and prove that they are still saturated with proteins. Thus, DEAE columns did not properly "clean" the Cohn Fractions, making it impossible to name a particular hormone that stimulates BM components. Another possibility is perhaps BM is regulated by at least two different hormones. This will add to the series of studies toward the goal of establishing key factors in the prevention of the complications of long-term diabetes.

#Second Award - ISEF/Medicine and Health

SOLUBLE INTERLEUKIN-2 RECEPTOR LEVELS IN HEART TRANSPLANT PATIENTS

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Organ Transplantation has become more commonly performed today. Since it deals with vital organs, careful monitoring is necessary post-transplantation otherwise rejection or infection may occur. Immunoperoxidase staining of tissue biopsies is performed to test for rejection but scientists have found that soluble interleukin-2 receptor (IL-2R) levels correspond with allograft rejection. This experiment's hypothesis states that soluble IL-2R levels will correlate with T helper cell-T suppressor cell ratios. Three control and thirty-four experimental blood samples were drawn. Plasma was isolated and stored at -20 degrees C and -80 degrees C. Testing for soluble IL-2R levels was performed through an enzyme immunoassay. The results showed that soluble IL-2R levels did not move in correspondence with T helper cell-T suppressor cell ratios. Although previous research supports the hypothesis, the results of this experiment did not. To conclude, soluble IL-2R levels do not reflect immunogenic reactions to allografts. Values of any sample stored at both -20 and -80 degrees C were not significantly different. These results led to the conclusion that storage temperature variation did not affect the soluble IL-2R levels. The last conclusion was that cyclosporine A values did not reflect the immune responses to allografts. Cyclosporine A values had a correlative pattern with soluble IL-2R values, but since IL-2R values are not a valid source for determining allograft rejection, neither are cycloporine A values. Hopefully more research will be done on the means of detecting rejection so future transplant patients can benefit.

# PHARMOCOLOGICAL EFFECTS OF PYOCYANIN EXTRACTED FROM *PSEUDOMONAS aeruginosa*

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The primary objective is to determine the clinical significance of pyocyanin in treating certain bacterial infections. This study is being conducted to research pyocyanin's growth optimization, extraction procedures, solubility, purity, stability, concentration, mode of action, antimicrobial activity, antimicrobial properties in comparison with known therapeutic agents, and the pharmacological effects of pyocyanin in *Mus musculus*.

A new culture media (Alanine) was developed, that when quantitated, exceeded the amount of pyocyanin produced by two other media by 33,000 and 36,000 ug per 2500 ml of broth.

An extraction procedure was developed using $CHCl_3$. Pyocyanin was confirmed to be 99% pure by performing thin-layer chromatography and reverse phase high pressure liquid chromatography. The concentration of pyocyanin was determined to be 600 ug/ml. Pyocyanin is soluble in nitrobenzene, pyridine, phenol, acetic acid, hot alcohol, benzene, hot and cold H_2O. Pyocyanin inhibits the following microorganisms better than the antibiotics currently being used: *St. aureus*, *St. epidermidis*, *E. coli*, and *Serratia marcescens*. Twenty four mice were divided into eight groups of three mice each. Each group was subcutaneously injected with 3 ug, 9 ug, 30 ug, 100 ug, 180 ug, 300 ug of pyocyanin.

Pyocyanin shows no toxic effects in mice at these levels, with the exception of one mouse in the 300 ug group which showed hepatocellular changes. In this study changes compatible with obvious toxicopathologic effects were absent. Pyocyanin shows no toxic effects in mice at levels, that in the laboratory, destroy harmful bacteria better than the antibiotics currently being used.

#First Award - American Medical Association
First Award - American Society for Microbiology
Second Award - ISEF/Microbiology

DOES ASPARTAME INCREASE APPETITE, CAUSING WEIGHT GAIN IN *MUS MUSCULUS*?

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Since Aspartame (more commonly known as NutraSweet) is a rising product in today's society, the purpose of this experiment is to see if it aids in weight loss.

First, research was done on the studies of aspartame. The information showed that aspartame is lower in calories than normal sugars, but it doesn't give the user the feeling of satiety that sugar gives, consequently one eats more.

To begin with, the mice were split into two groups, a control group and a NutraSweet group. The mice were fed the same amount of high protein food, however the NutraSweet group was fed .12 grams of Equal per .05 liters of water, while the control group had regular water. The mice were fed and watered every day for two weeks after they were weened. Each day the mice were weighed. After the two week period, T-values were calculated using the weight gain of each mouse. The T-values showed that even though the NutraSweet mice did gain more weight, there was a 20 percent chance that this difference was not due to the NutraSweet. However, this result warrants more testing.

THE EFFECT OF LIDOCAINE ON NPV INFECTIONS

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It has recently been demonstrated that topical applications of Zn^{+2} containing salts reduce the severity of nuclear polyhedrosis virus (NPV) infections in wax moth larvae. Exposure to high exogenous supplies of Zn^{+2} retards Ca^{+2} and Mg^{+2} uptake along with inhibiting DNA, RNA, and protein synthesis (Saddorris and Miller, 1986a; 1986b; 1988). In explaining these results, Saddoris and Miller (1988) offered a hypothesis that implies that all Ca^{+2} blocking agents would act as anti-viral agents. As a result, this project investigated whether or not the Ca^{+2} blocking agent lidocaine impairs NPV infections in wax moth larvae.

Data from this study indicates that topical application of lidocaine does impair NPV infections in wax moth larvae. This was found by modifying the technique of Saddoris and Miller (1986a; 1986b). Data from this study also indicates that lidocaine does indeed block Ca^{+2} uptake and Mg^{+2} uptake. In addition, it appears that lidocaine also reduces the endogenous levels of protein and RNA within NPV infected wax moth larvae. This data would seem to support the hypothesis of Saddoris and Miller (1988). That is, Ca^{+2} blocking agents do appear to act as anti-viral agents.

Phthalate Inhibition of Polyphenol Oxidase

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Previous research showed that phthalates exerted an adverse effect on plant growth. A review of the literature suggested the possibility of interaction with enzymes involved in oxygen metabolism. Copper bearing enzymes in particular may be of interest with phthalates inhibiting by chelation. O-diphenol oxidoreductase (PPO) was chosen as a test system with catechol as a substrate. The prime objective was to study the effects of dibutyl phthalates on the enzymatic activity of PPO and to determine the emchanism of such an effect. I wished to determine if dibutyl phthalates chelate copper ions from the enzyme and inhibit the reaction. Using a light spectrophotometer I measured the percent transmittance of light emitted as the PPO converted the catechol to 1,2-Benzoquinone and compated these results with the measurements of the same reaction with the addition of phthalates to each test. Enzyme kinetic studies were done with the results. I plotted according to Lineweaver Burke and determined a competitive inhibition. The phthalate molecule is similar in shape to the catechol molecule and is able to fit into the active site on the enzyme. The site on the enzyme could be similar to the shape of the phthalate molecule and on contact the larger phthalate molecule could cause conformational change in the enzyme.

The reason for my experimentation was to understand the mechanism of phthalate inhibition and to extend this to effects in the human system. If the phthalate molecule fits into the active site of anzymes which use catecholamine-like substances, the production of neurotransmitters could greatly affect the human nervous system.

#First Award - American Medical Association
Second Award - ISEF/Medicine and Health

LONG-TERM COMBINED EFFECTS OF TRACE ELEMENTS & FOOD ADDITIVES (Cu^{++},MSG)

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Monosodium Glutamate (MSG) has been shown to produce many adverse effects in humans, including migraine-like headaches, psychiatric reactions, and severe asthma. However it is on the Generally Recognized As Safe (GRAS) listing of the Food and Drug Administration, and is used in many restaurants and in factory prepared foods. Another relatively recent common addition to human diet is Cu^{++}, from copper water pipes. This experiment studied the long-term combined effects of monosodium glutamate and copper on the motor activity of gerbils. Over a period of eleven months, twenty-one gerbils were given doses of MSG ranging from 2.5 mg to 10 mg per day in their drinking water, amounts equivalent to those encountered by humans in a normal present-day diet. At times, copper sulphate was also added to the water in the amount of 0.1 mg or 1.0 mg/1000 ml. (The accepted level of Cu^{++} for drinking water is 1.0 mg/1000 ml.) Activity was then measured daily on exercise wheels. The motor activity of the gerbils was significantly depressed for the first 24 hours on MSG. Over a nine-month period, an over all decrease of activity was seen in the gerbils that received MSG. The gerbils' motor activity also appeared to be affected by Cu^{++}, but it is uncertain to what extent. Studies are now needed to see if similar long-term effects occur in humans.

EFFECTS OF TESTOSTERONE ON MICE

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In my project, I tried to find adverse effects of testosterone on mice. I took six laboratory mice and injected four with aqueous testosterone at doses one and one-half and three times human replacement therapy to observe weight changes and possible behavioral changes. The mice were separated into pairs, each pair given a separate cubicle for observation. The control group received no injections. The materials used were an insulin syringe, Troemner balance, and testosterone suspension 100mg/ml.

To inject the mice, the testosterone suspension was diluted to 0.025mg./.05ml and 0.05mg./.05ml. This made the suspension one and one-half and three times the equivalent human dose respectively.

During my tests, a litter was born to an injected female and one control female. The young of the injected female were twice the weight at birth of the control young. The adolescent mice nursing from the testosterone injected female did show conclusively advanced growth and maturation. These mice showed advanced sexual development at two weeks of age. The sex of the control young could not be determined at two weeks of age. The injected mice became aggressive, but their weight gain was no greater than that of the controls.

From the results of my experiment, testosterone should only be used as a replacement hormone in humans when the natural hormone is absent or greatly reduced.

REACTION TIMES, HOW DO YOU MEASURE UP?

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The purpose of this project was to measure and compare male and female reaction times of different ages. By using five males and five females from the sixth, eighth, tenth, and twelfth grade, average reaction lengths were obtained. A yardstick dropped above the hand was caught by each student, and the distance was recorded. After recording this information for each student, the lengths were averaged for males and females to show the differences. Males proved faster than females in every grade tested. This may be due to stronger male competitiveness and higher muscle to weight ratio.

STUDY OF EXTRINSIC & INTRINSIC FACTORS AFFECTING NICKEL ALLERGIES.

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The skin is a common "shock organ" for many allergens. The most common type of allergic skin irritation is contact dermatitis, and a nickel allergy is the most common contact allergy among women. This study will determine 1) if there is any significant relationship between the age and sex of each subject and being sensitive to the nickel and 2) if there is any significant relationship between the alloys found in the ear piercing stud and being sensitive to the nickel.

Participation consent forms/questionnaires were distributed among the subjects in each of four age groups (5-12, 13-18, 19-30, and 31-50). Each subject was asked to apply a nickel on the inner aspect of the subject's brachium with hypoallergenic tape for a period of 48 hours, provided no significant irritation developed. The forms were collected after the 48 hours were concluded, and the data was then analyzed.

Based upon the data, the following conclusion may be drawn: 1) Both male and female subjects in the 5-12 and 31-50 age groups were more sensitive to the nickel when compared to the other age groups. 2) Overall, the females were more sensitive to the nickel than the males were. 3) There was not a large difference in the relationship between having the ear pierced and being sensitive to the nickel in any of the age groups.

The Effects of Selected Visable Radiation of C. xerosis

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Knowing that ultra-violet (U-V) radiation has been used as a form of sterilization for many years, and knowing of the harsh effects that U-V radiation has on humans and various animals, this project sought another form of radiation sterilization that would not have the same destructive tendencies as U-V radiation does. It was decided to test nine different forms of visible and invisible forms of radiation. Various filters were obtained to produce the seven colors of the spectrum. For the microwaves, a microwave oven was utilized, and for the infra-red, an infra-red heat lamp was used. In addition , U -V radiation was used to provide a means of comparison for the bacterial destruction of the other forms of radiation. Upon culturing forty plates of C. xerosis, twenty on beef broth agar and twenty on sheep blood agar, experiments were conducted with each of the radiation forms. After experimentation, it was found that U-V was most effective; however both infra-red and red light radiations produced excellent results. Results indicate that incandescent light which is rich in radiation at approximately 630nm is conducive to bacterial growth and should be avoided if this is not desired. Fluorescent light is rich in radiation of approximately 520nm and has a tendancy toward bacterial growth inhibition. Research shows that associated infra-red radiation has similar effects.

DIABETES - A BALANCING ACT

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Diabetes is a disease in which the body does not produce or properly use insulin, a hormone needed to convert sugar into energy. It often leads to serious complications that involve nearly every tissue in the body. There is no cure for diabetes, but research is making exciting progress in the treatment of people with the disease.

The disease of diabetes is quite a balancing act to manage. Research indicates that careful control of the variables of diet, exercise, and insulin keep blood glucose levels in the normal range, thus decreasing the chances of diabetic complications in later life.

My investigation was made to determine the effects of different foods and exercises on blood glucose levels. These levels play a key role in mental functioning. The functions of logic and reasoning, hand-eye coordination, spatial relationships, short-term memory, and reaction time were tested. By recording glucose levels, controlling food intake, and structuring an exercise schedule, several conclusions can be made. According to this experiment: cycling lowers blood glucose the most, followed by jump roping, jogging and frisbee. Diet and rate of metabolic response are crucial in diabetic control. Generally, low blood glucose slows and disables mental functions.

A possible application of these results would be the development of a glycemic index. This could be a better means of formulating an individual diabetic diet plan, rather than using the caloric scale.

On a more psychological view, the diabetic subject I tested now feels more confident and in control of his disease, instead of his disease controlling him.

HISTOLOGICAL, TOXICOLOGICAL, "IN VIVO" STUDY OF EFFECTS ASCORBIC ACID ACTION ON CHOLESTEROL LAMELLAE FORMED IN ARTERIAL AND CARDIAC TISSUE OF *LEPUS CUNICULI*

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The first phase of this work determines the decrease in cholesterol in tissues when submited to high Vitamin C diets. Organisms were classified in three groups control, normal diet, and experimental group.

The second phase consisted of investigating the effects of Ascorbic acid on cholesterol lamellae formed on *Lepus cuniculi's* blood vessels. Determination of proper doses of Ascorbic acid to be applied to organisms using toxicological tests. Tests were performed both intravenously, and orally adequate doses of Ascorbic acid determined as being 0.4 cc of Vitamin C in normal saline solution, to be used intravenously, and from 150 to 250 mg; to be used orally. Two groups with high cholesterol diets and a control group were used. Blood samples were taken from organisms both prior and after having ingested high cholesterol diets as well as after having been treated with Ascorbic acid.

An "In Vivo" study was performed on cholesterol lamellae of femoral arterial tissue placed on culture media to retain normal, vital functions. Ascorbic acid was applied to determine changes taking place in cholesterol lamellae present in tissues.

Positive results were obtained through out the whole investigation; a 100% of all tests performed demonstrated a marked decrease in cholesterol lamellae's levels in tissues.

* SPOTS, SPOTS, I SEE SPOTS - A HISTOLOGICAL EXAMINATION OF XANTHOMAS IN THE IRIS OF WHHL RABBITS

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White spots were observed in the eyes of five eleven-month old Watanabe Heritable Hyperlipidemic (WHHL) rabbits homozygous for atherosclerosis. These spots, or xanthomas, were studied to determine their location and content.

The xanthomas were located in the iris and presumably developed from atheromas, blood vessels clogged by lipid accumulation. Further investigation showed that the xanthoma consisted mainly of foam cells, needle-like cholesterol clefts, and newly formed blood vessels. In addition, some multi-nucleated foreign body giant cells and areas of lipid deposit were observed. Histological stains of frozen sections demonstrated that cholesteryl esters, complex and neutral lipids, and small amounts of calcium were present in the xanthomas and presumed pre-xanthoma blood vessels of the WHHL iris, but were not present in the irises of control rabbits. Free cholesterol staining was negative in both.

Previous investigators utilized limited histological stains. This project, through the use of comparative staining techniques, attempted to accurately identify the contents of the white spots and find a correlation between the spots and the partially clogged blood vessels in the iris. Although xanthomas of this type have not been noted in the human eye, Cogan and Kuwabara (1959) noted similarities between human ocular atherosclerosis and xanthomas in rabbits. Thus the WHHL rabbit may provide an excellent model for the study of atherosclerotic plaque in humans.

*London International Youth Science Fortnight Trip - U.S. Army
First Award - Eastman Kodak Company
First Award - U.S. Army
Third Award - ISEF/Medicine and Health

LEUKOCYTES IN PERIPHERAL BLOOD: A STUDY OF NORMAL VARIATIONS-PHASE II

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White Blood Cells (WBC) form an important part of the body's defence mechanism and are the object of this study. The cells were identified and categorized in eight morphological groups: Neutrophils, Bands, Eosinophils, Basophils, Monocytes and Small, Large, and Reactive Lymphocytes in each of 100 peripheral blood smears.

The smears were randomly selected from adults (16 and older) with "normal" total counts of 4,000-10,000. The data was analyzed using various criteria such as age, sex and occupation. Analysis of Variance (ANOVA), a statistical tool, was used to determine the significance of variations. The author's data was also compared with counts obtained by laboratory staff on the same 100 smears. Data from 80 smears from Phase I were included for sex and age comparisons.

Occupation and age demonstrated no statistically significant variation. The lab-generated data showed a greater difference between males and females compared to the author's data but otherwise corelated very closely except for distribution of Neutrophils and Bands. The author found a greater proportion of bands reflecting bias in identification of bands. However, the aggregrates of Bands and Neutrophils were virtually identical in the two sets of data. This study also supports the view that "normal" values for population can be obtained by studying large numbers of unselected samples, including samples from ill persons.

* BEHAVORIAL & PHYSIOLOGICAL CHANGES IN MICE DUE TO ALUMINUM

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The purpose of this project was to determine the behavioral and physiological changes in mice due to the ingestion of aluminum.
Aluminum, in a hydroxide gel form, was placed in the water of the test mice. To determine the changes, five tests were run: basal metabolic rate, urinalysis, hemoglobin, individual behavioral patterns, and male-female behavioral patterns.
Throughout the testing it was found out that the mice ingesting the aluminum had a lower basal metabolic rate and hemoglobin level as compared to the control mice. These test mice were urinating four times as much as the controls, were more hyperative, sexually aggressive, had a slower reaction and response time, and less muscle control than the control mice. Aluminum is directly and indirectly affecting the behavioral and physiology aspects of the mice. Thus I have concluded that aluminum is being deposited in the bone marrow, causing either a decrease in production of red blood cells, or the destruction of the new red blood cells. I also conclude that the aluminum is being deposited in parts of the brain.

*Third Award - ISEF/Medicine and Health

FLUORIDE ANALYSIS OF THE BLACK CREEK AQUIFER SYSTEM

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HYPOTHESIS: The Black Creek Aquifer System contains high fluoride levels that are responsible for an unusually high number of students in my school to have dental fluorosis.

METHODOLOGY: The SPADNS method was used to determine the fluoride ion level in the potable water of 27 students who appear to have dental fluorosis. The method relys on the fluoride ion to react with a zirconium oxycloride-SPADNS lake to give a colorless complex. The increase in transmittance (inverse spectrophotometry) at 580 nm is correlated to the concentration of the fluoride ion in the samples taken. Sodium 2-(parasulfophenylazo)-1, 8-dihydroxy-3, 6-napthalene disulfonate (SPADNS) in an acid solution was used to allow the reaction between fluoride and zirconium to proceed very rapidly.

CONCLUSION: Most recent studies conclude that potable water containing concentrations of 2.0mg F^-/L or more may cause dental fluorosis. Twenty-one of the 27 samples tested yielded concentrations above this level. The remaining six samples were near or at this level.

RECOMMENDATIONS: In a news article that appeared in a local newspaper two years ago, DEHEC of South Carolina was quoted: "There's nothing wrong with the water here. It's perfectly safe to drink." From the results of my study it may be concluded that our water supply is very unhealthy. I have used the information gained in my research to try to influence all towns in Horry County to contract their water to a water authority so that the fluoride level may be maintained at a level below 2.0mg F^-/L.

NUTRIENTS OF SACCHARUM OFFICINARUM AND ITS EFFECTS...

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Saccharum officinarum, or sugarcane, contains many nutrients that are useful to the human body(Jones, 1929-36). Study I investigated whether these nutrients preserved in cane syrup had an effect on arthritis or other human disorders. Steen's Pure Ribbon Cane Syrup was chosen as the carrier because its sulfated ash content was higher than other tested syrups. Eight human subjects were experimented with. Improvements were shown in the areas of arthritis, energy level, and overall physical health. The conclusions to this In Situ field study were that there were grounds for further experimentation in order to determine the reasons for the results rendered in the given areas.

Study II compared Steen's syrup to other commonly consumed food products. This was done by determining the sulfated ash content of each. This was considered to be the critical components in rendering the possible effects. The ash content per serving of each given substance was then determined using measurements and a direct variation. Steen's syrup contained a significantly higher ash content per serving than most other commonly consumed food products tested. This further supported the observations cited in the first study. The investigation was carried a step further as a wide variety of foods and their contents were studied. Findings indicated that the ash consumed from the syrup was likely to have an effect upon one's diet. Thus, the syrup contains the nutrients in great quantity.

THE ROLE OF ANTIOXIDANTS IN THE REMOVAL OF FREE RADICALS

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The purpose of this project is to test the validity of the free radical theory of aging: A great deal of aging and degenerative diseases stem from the production of free radicals (molecules with unpaired electrons in their outer shells) during cellular respiration. Thus, over time mitochondria, DNA, and other organelles are damaged by free radicals. Free radical inhibitors neutralize free radicals, removing them from the cell.

It has been suggested that through the ingestion of the free radical inhibiting antioxidants Vitamin E and BHT, there will be an increase in average and maximum lifespan in experimental groups of Drosophila Melanogaster (fruit flies) over control groups due to the removal of damaging free radicals by the Vitamin E and BHT.

Six vials were set up. The control vial consisted of food and flies. The experimental vials consisted of flies and food mixed with varying concentrations of BHT and Vitamin E added alone in two vials and together in three vials.

The flies were reared from egg in the presence of their designated chemicals. The lifespan of the adults were monitored. The experiment was run twice . Average lifespan of the flies in four vials increased significantly over the control vial. Maximum lifespan in two vials increased significantly over the control vial. The conclusion was: The ingestion of free radical inhibitors removed damaging free radicals in Drosophila Melanogaster thus increasing average and maximum lifespan by preserving vital cellular organelles.

Morus migra-Study of its Anti-diabetic properties on diabetic M. musculus

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Bohique CC 3 Res. Bairoa, Caguas, PR 00625

Morus migra grows in tropical regions. My investigation deals with its effects on biological systems. Plant infusions were given orally to patients with diabetes.

Phase I consisted of a inquest among patients in clinics. Forthy five percent of patients had knowledge about the use of this plant for diabetes control.

Phase III consisted of a pharmacological analysis in Artemia salina using different concentrations of the plants extracts.

Phase III consisted of the use of Mus musculus diabetized with Strebtozotocin and centrols glucase tests were performed regularly; nutritional and physical activities were also considered.

Phase V consisted of biochemical tests to determine the active agent present in Morus migra.

Data and results obtained demonstrate that the plant has curative effects on diabetic patients.

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*MONOCLONAL CHARACTERIZATION OF OCULAR LENS PROTEIN-PHASE IV

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Aging is theorized to be caused by defective protein. Furthermore, it is known that this protein content decreases in the ocular lens as one ages. By studying the "fate" of these proteins, it is possible to study aging and cataractogenesis (the development of the opacification of the lens due to insoluble protein). Monoclonal antibodies are helpful "biological tools" in undertaking this task. The purpose of this project is to characterize four clones of monoclonal antibodies for their specific ocular lens protein.

Slides were prepared with sections of embryonic chicken lenses on them. Photographs were taken under immunofluorescence microscopy to show where the clones of monoclonals attached to their specific lens protein. To further characterize the monoclonals, an SDS-PAGE was performed. This procedure separated the lens protein on the basis of molecular weight. Next, a Western blot was performed to determine exactly to what protein the monoclonals became bound.

The results of the immunoflourescent photographs showed that the two clones within each pair stained similarly; however, further analysis proved that all the clones were different. Amazingly, all clones were specific for proteins of low molecular weight suggesting that they are the crystallins. Crystallins are lens-specific structural proteins believed to determine the transparency of the lens. More tests will need to be undertaken to determine if the antibodies are for the crystallins. Eventually, a developmental study can be attempted comparing the "fate" of proteins from different aged lenses. This may yield the long sought information regarding aging and cataractogenesis.

*Third Award - ISEF/Medicine and Health

ALTERATION OF CYTOSKELETAL ACTIN FILAMENTS IN INFECTED LYMPHOCYTES

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In my investigation, I determined whether alteration of cytoskeletal acin filaments in lymphocyte cells correlated with FeLV infection and then studied damage done to normal cells as FeLV infection progressed in co-cultivation. Actin is the most abundant protein in the cytoskeleton, usually representing 5-10% of thetotal protein. When the cytoskeleton is damaged, the functional ability of the cell to fight viruses is repressed.

The feline leukemia virus (FeLV) was discovered in 1964 and is now known to be a major cause of suffering and death in pet cats. Part of the enthusiasm for FeLV research is due to the belief that the feline retroviral system is an unusually appropriate model for human leukemia which can be caused by HTLV-I. The major vehicle for transmitting the virus is saliva. Licking or biting enables the virus to infect cats via the ocular, oral, and nasal membranes.

In the first stage of my project, I studied one cellline from each of 11 cats and calculated the percentage of cells which tested positive forFeLV. Next, I took the cells which tested positive for FeLV and measured the percentage of those which showed altered filaments. My results show that of the 69.3 percent of the cells which tested positive for FeLV, 88.6 percent showed alteration of the cytoskeletal actin filaments. Of the cells negative for FeLV, noneshowed alteration.

In the second stage, I took samples of normal cells which had normal actin and co-cultivated them with samples of FeLV cells to visually measure the rate and amount of filament alteration occuring as the normal cells acquired FeLV. By the third day, my results show that approximately seven-eighths of the cells showed at least some alteration of the cytoskeletal actin filaments, stronglyindicating that it was FeLV which caused the alteration.

My hypothesis was correct; FeLV does alter the cytoskeletal actin filaments making up the structure of normal lymphocyte cells.

CONTRACEPTIVE PROPERTIES OF SOFT CARBONATED DRINKS

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INTRODUCTION: Contraception is a method or practice used by two persons of the opposite sex, with fecundant capacity, for the purpose of preventing the conception in the sexual act. The over population is a problem of world wide concern, because of it, science is looking for more contraceptive methods with no secondary effects to the organism. **PURPOSE**: To investigate and analize the potential of three carbonated soft drinks, as a contraceptive and verify the effects produced by vaginal douche in the gestation process of the white mouse (mus-musculus). **HYPOTHESIS**: If three types of carbonated soft drinks were applied in proportions such as 100,75,50 & 25 percent, deluted with destilled water, to the reproductive systems of female mice, during mating, will it cause retardation or anulation effects on conception, thus demonstrating its efficiency as a possible contraceptive for mus-musculus. **PROCEDURE**: Prepare different cages with experimental and control mice. Prove their fertility. Devide the cages according to the dilution percentage of three different carbonated soft drinks to be used for the mice's vaginal douche. Apply individually .1cc. The mice are then left toghether 3 to 5 hours. Separate them and repeat the procedure. **RESULTS & CONCLUSION**: It was found that of three different carbonated soft drinks, some retarded the gestation process while one of them prevented conception completely. In conclusion, the carbonated soft drink; Diet Coke, evidenced having a contraceptive potencial for mus-musculus.

IN VIVO CLONING OF B16-F10 CELLS THAT SPECIFICALLY METASTASIZE TO LYMPH NODES

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Most cancer cells have the ability to spread from one primary tumor site to other parts of the body. B16-F10 melanoma cells, a type of black pigmented cells, are known to spread selectively to lungs after intravenous injection. The objective of doing this experiment was to determine if B16-F10 cells surviving 10 Gy X - irradiation and in vivo cloning spread selectively to lymph nodes after intravenous injection using in vivo cloning methods not previously described for lymph nodes. General autopsy was done after the mice were intravenously injected with cloned B16-F10 cells. The results indicate that the cloned B16-F10 cells surviving irradiation are more capable of spreading to lymph nodes and are biologically different from their parental B16-F10 cell population.

#First Award - American Medical Association
Third Award - ISEF/Medicine and Health

THE EFFECTS OF ANABOLIC STEROIDS ON MUS MUSCULUS

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This experiment was constructed to observe the physiological and behavioral changes in Mus musculus when injected with an anabolic steroid. The steroids used were testosterone and Nandrolone Decanoate and a control solution of saline. The mice were weighed weekly, behavior observed, and vaginal cytologies preformed for an eight day period on the females. All steroid males were not muscular, but they had a "fatty" look to them. They had a greater fat content than did the control; therefore, they weighed more. When taken off the steroid both testosterone male and female mice lost weight rapidly and looked less muscular, while those on Nandrolone Decanoate lost weight slowly and remained muscular-looking. The steroid mice were more aggressive and often tried to kill their partners. Physiological changes were: enlarged male sexual organs, peeling of the skin, and hair loss. The estrous cycle was very irregular in the testosterone female, and she became pregnant and had several deformed young. The young's facial features were more condensed. Their eyes were very close together and appeared to be very sensitive to light. Nandrolone Decanoate females were infertile and had no offspring. The estrous cycle stayed in diestrous.

EFFECTS OF CIGARETTE SMOKE ON THE DEVELOPMENT OF COTURNIX EMBRYOS

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Through my project I hoped to gain substantial information on the effects of smoke on the development of the coturnix embryo. To do this, I simply exposed thirteen eggs to cigarette smoke twenty minutes a day while leaving thirteen as controls. Upon completion of the experiment, I found that the variable embryos weighed, on an average, 0.72 grams less. This comes out to a 13.77% difference in average weights. So as a conclusion, I would say that the smoke definitely decreases embryo weights to a certain extent. This conclusion may possibly tie in the studies done on the human fetus in the cases where the mother smokes.

*EFFECTS OF HYPERTHERMIA OR RADIATION ON CELL KINETICS USING FLOW CYTOMETRY AND THE DEVELOPMENT OF A CLONOGENIC ASSAY IN THE R3327G PROSTATIC ADENOCARCINOMA

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The creation of an artificial metastasis system for the experimental prostate tumor (R3327G prostatic adenocarcinoma) to imitate the nature of the human prostate cancer is the main objective of this first part of the project. Rat lungs are removed and are passed through a series of clearing-and-staining procedures. This allows an accurate and efficient quantitation of tumor number and size. It provides a direct and accurate method for the analysis of cells capable of growing into tumor cells. This assay makes it possible for chemotherapy, hyperthermia, radiation, and other therapeutic techniques to be developed for the human prostate cancer through rat studies. It can provide a correlation for potential developing tumor cells, and to determine the maximum therapeutic ratio of tumor cells by applying some therapeutic techniques.

A new method to determine the DNA synthesis time (Ts) of the Dunning R3327G prostatic adenocarcinoma by using flow cytometry to measure bromodeoxyuridine incorporation at several time periods after its injection is also described. Data obtained from biopsy samples through flow cytometric analysis of BrdUrd incorporation and DNA content are calculated to find the duration of s-phase and potential doubling time of the tumor. Calculation of the cells through s-phase can also be established once the relative movement is known. The results obtained seem to agree with recent published estimates for the Dunning R3327G prostatic adenocarcinoma. The effect of hyperthermia or radiation on the cell kinetics of this tumor is studied through the flow cytometric technique to improve the accuracy, reduce the expenses, and speed up the studies for prostate cancer.

*Fourth Award - ISEF/Medicine and Health

WEIGHT CONTROL - FATS OR CARBOHYDRATES

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This study was done to see which type of diet creates the highest amount of weight gain - one high in fat, complex carbohydrates or simple carbohydrates. Also to study, by survey, peoples background and eating habits to determine the reason for their present weight.

I fed three different groups of rats each a different diet for twenty five days. Group one was fed a diet high in fats. Group two was fed a diet high in complex carbohydrates. Group three was fed a diet high in simple carbohydrates. Rats were weighed on a digital scale every five days for analysis. Surveys were given to individuals asking family weight background, types of food eaten, intake of food for a week and reducing diets tried.

Rats eating complex carbohydrates lost weight and ate 1½ times the volume of food as the other two groups. Rats eating fat diet gained more weight than those eating simple carbohydrates. Those eating complex carbohydrates had more energy than those eating simple carbohydrates or fats. Analysis of survey indicated results similar to those of my rats. People eating diets containing a lot of complex carbohydrates were close to ideal weight. Those overweight consumed a lot of junk food high in fats and simple carbohydrates.

People eating diets high in fats and simple carbohydrates will gain more weight than those eating diets high in complex carbohydrates.

IN VIVO/IN VITRO ASSAYS FOR POSSIBLE ANTINEOPLASTIC AGENTS OF NATURAL PRODUCTS CD-1 MUS-MUSLUSCUS MICE

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Eight extracts of the following plants were tested in the brine shrimp medium: 1. Lycoperdicon lycopersicum - Tomato, 2. Catharanthus roscus - Periwinkle, 3. Brassica oleracea capitata - cabbage, 4. Brassica oleracea gemmifera - Brussels sprouts, 5. Beta vulgaris - Beet, 6. Sicana odorifera - Cassabanana, 7. Citrus limon - lemon, 8. tagetes patula - Marigold. The findings of this research suggest that the eight plans extracts have activity, upon the brine shrimp.

The Mus-musculus mice were divided into ten groups of five mice each. there were two control groups: one was uninoculated, the second was inoculated with .1 ml of EAT but untreated. Each one of the others was daily treated with the plans extracts (the extracts were made with 28g of the plant and 250ml. of distillate water). The findings showed that the eight plants are toxic to malignant cells because there were 60% - 100% of supervivors. The resuls of the histological study showed that the two best effective extracts are lycopersicon lycopersicum and catharanthus roseus. Although, all the extracts had effectiveness upon the control of malignant cells, ones wewe better than the others.

It was corroborated with the mortality trend during the first 21 days of treatment. It showed that mortality percentage varied between 0-40%. The hemathology test showed important changes between the values obtained between the control group inoculated with EAT and the other groups treated with the extracts. The phytochemical analysis includes partitions, TLC, and column chromatography.

#Fourth Award - ISEF/Medicine and Health

DEMONSTRATION OF PROSTAGLANDINS IN THE RESPIRATORY TRACT USING IMMUNOCYTOCHEMISTRY

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Few substances currently command more attention than do the prostaglandins. They have been detected in almost every tissue and are integrally involved in the control of several important physiological functions including smooth muscle relaxation and constriction, platelet aggregation, sensitization of afferent nerve endings, modulation of renal blood flow, and inflammatory and immune responses. The purpose of this study was to develop an immunocytochemical technique for the detection of prostaglandin synthetase (PGS) activity in the respiratory tract of hamsters. Respiratory tissues from 16 hamsters were fixed in 1% paraformaldehyde (PF), 2% glutaraldehyde (GA), ethanol-acetic acid (EA), or were quickly frozen at -70 C. Histologic sections from each fixation group were incubated with anti-prostaglandin synthetase followed by a secondary antibody conjugated with either FITC or an avidin-biotin complex. PF provided the best combination of morphologic preservation and retention of PGS antigenicity. Both the FITC and avidin-biotin techniques yielded comparable demonstration of PGS activity localization, but the latter had the advantages of superior visualization of cytologic detail and lacked the fading with time found with FITC. PGS activity was highest in the columnar cells lining the trachea, bronchi and terminal bronchioles, in Type II cells, and in endothelial cells. Ciliated cells showed little activity.

* INDUCING MUSCLE CONTRACTION BY STIMULATION OF NEURONS WITH IN VITRO NEUROMUSCULAR JUNCTIONS.

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The purpose of my research was to demonstrate functional neuromuscular junctions between sympathetic neurons and smooth muscle cells in primary, multiple layer, tissue culture. Sympathetic neurons, obtained from the right stellate ganglia, were cultivated in vitro. Smooth muscle cells, obtained from the thoracic aorta, were then introduced to the culture and allowed to reach a confluent, multiple layer state corresponding to aggregate formation in standard culture. The neurons were then stimulated with a bipolar, extracellular electrode. The contractions caused by this stimulation were measured photoelectrically.

The innovative methods of tissue culture that have been developed through this research may hold the key to better understanding the interactions of the neuromuscular system, in that they provide a means by which an in vivo system can be recreated and observed in an in vitro setting. Thus these methods provide a means to assay of neuromuscular interactions and disorders, such as myathenia gravis and muscular dystrophy in a laboratory setting.

*Scholarship - U.S. Navy
First Award - American Medical Association
First Award - ISEF/Medicine and Health

THE BIOHYBRID ARTIFICIAL PANCREAS

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Approximately 11 million people in the world have diabetes, and many more are affected by it; therefore, a "cure" would change our society in a terrific way. The artificial pancreas contains a duo-filtering system. Blood enters the encasement, flows around the circular filter, and exits the device. While most of the blood and blood particles flow past the filter, glucose passes into the filter. Once it is inside the filter, it triggers the release of insulin from the beta cells which are inside the filter.

The whole purpose of the experiment was to filter out the white blood cells while glucose remained in the blood. This year's filtering process used diabetic and nondiabetic rabbits' blood. Glucose levels of the blood were tested before the filtration process began. A 5 micron filter was used for filtering. After the filtering process was completed, the blood was again tested for glucose levels. It could be determined whether or not white blood cells(lymphocytes) were removed by the filter by viewing microscope slides of the blood filtrates.

Once the blood is filtered to obtain glucose as a filtrate, the beta cells on the resultant side of the filter (which produce insulin in the pancreas) would be stimulated to produce the needed insulin.

This is the second in a three year study involving the artificial pancreas. Prior experimentation using Blue Dextran and a .2 micron filter was conducted to prove that insulin molecules would pass through the filter in the artificial pancreas. A ratio of 1:10 was used as a basis of comparison between the .2 micron filter and the artificial pancreas. Next year's study will hopefully include more advanced experimentation with the engineering of the artificial pancreas.

LIPOSOMES: A BREAKTHROUGH IN CHEMOTHERAPY?

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Patients weakened by the toxic side effects of chemotherapy often succumb to other illnesses. The toxicity is due to the interaction of the drug with various body components other than the site of infection. This project explores a mode of drug delivery in the treatment of fungal disease in which the drug is encapsulated in a multilamellar vesicle (MLV) or liposome. A liposome is a phospholipid vesicle and MLVs are preferentially phagocytosed by macrophages which carry them to the liver or spleen, two common sites of fungal infection. In this project several in vitro studies were performed to test the efficacy of this mode of drug delivery. Tests to compare the toxicity of the free and liposomal form of several polyene antibiotics (antifungal drugs) and the effect of serum to modulate any toxicity was tested on red blood cells (RBC's). The effect of encapsulation on the rate and efficiency of uptake by macrophages was studied on the drug that showed the greatest promise in the RBC toxicity studies. Further tests were performed to see whether direct contact was necessary for the transfer of drug or if the drug is released from the liposomal membrane and then interacts with cells. The results show that liposomal encapsulation effectively shielded the RBCs from the toxicity of only the large polyenes. Serum masked the toxicity of four of the five drugs tested. Amphotericin B gave the most promising result and was used in further testing. The liposomal form of this drug was taken up in greater quantities than the free form by macrophages and the uptake was maximal at 24 hours. Direct contact is required for the transfer of the drug from the liposome.

THE PREDICTIVE VALUE OF AN ANTIBODY FOR THE DIAGNOSIS OF MELANOMA

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Some monoclonal antibodies have proven to be useful to help with the diagnosis of human tumors. A monoclonal antibody to a protien known as S_{100} is the current standard 'marker' antibody for the diagnosis of the tumor known as malignant melanoma. Anti S_{100} is a less than ideal marker for melanoma since it has been shown to react in tumors other than malignant melanoma.

A new monoclonal antibody known as HMB_{45} has been proposed as a marker for malignant melanoma. To assess its usefulness, this study has 10 various normal tissues, 10 cases of tumors other than melanoma, 14 known cases of malignant melanoma and four additionally difficult diagnostic cases which proved to be non-melanomas, diagnosed by experienced pathologists. It was found that HMB_{45} did not react with normal tissues or non-melanoma tumors and therefore had a specificity of 100% . However only 12 out 14 melanomas reacted positivily for a sensitivity of 85.7% . S_{100} was 100% sensitive but only 25% specific for melanoma. The predictive value of positive HMB_{45} was 100% as compared to S_{100}'s positive test which was only 57% . HMB_{45}'s negative predictive value was 87.5% and the predictive value of negative S_{100} was 100% . The overall efficiency of HMB_{45} was 92.8% while S_{100} had an effieciency of 62.5% . Both antibodys in a combination have great utility for the surgical pathologist in distinguishing malignant melanoma from other types of tumors.

SELENIUM-MEDIATED DERMATITIS IN UV-IRRADIATED HRS/J MICE

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Skin cancer affects 1 in 7 Americans, killing 7,800 people annually. Selenium, one of many possibly anticarcinogenic substances being tested, is reported to have chemopreventive effects on liver and breast cancers. In a study designed to learn if selenium inhibits skin cancer, oral doses of 0 (control), 4 and 8 mg selenium per liter (as sodium selenite) were added to distilled _ad lib_ drinking water of 45 female hrs/J (hairless)mice irradiated daily for 20 weeks with UV A and B light. Selenium supplementation was begun 3 weeks before initial UV exposure and was continued for the duration of the experiment. Although to date, none of any specimens have developed skin cancer _per se_, pronounced skin lesions, identified after biopsy as deep dermatoses and acanthoses, appeared in all groups after several weeks' irradiation. High-dosed (8 ppm Se/l drinking water) mice developed the fewest (7.1%) lesions, gained 2% more weight than did other treatment groups and drank nearly 15% less water than mice given no selenium. No apparent acute nor subacute toxicity was observed in either selenium-treated group. The data suggest that in mice, oral selenium at 8 ppm is non-toxic and is possibly effective in reducing or preventing skin damage from UV light. By demonstrating a known phenomenon, specimens' water intake data suggest that selenium may tend to somewhat inhibit fluid loss in irradiated mice. Although highly theoretical, based on its fluid conserving action, oral or parenteral selenium might be potentially therapeutic in the reduction or prevention of fluid loss in certain illnesses which cause dehydration, as in severe burns. This investigation has been extended for an additional 20 weeks to determine if dermatoses in currently studied subjects become malignant, and to further document selenium's ability to inhibit fluid loss post-irradiation.

THE EFFECT OF PRE-EXERCISE SUCROSE INGESTION ON POST-EXERCISE BLOOD GLUCOSE

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The main purpose of this experiment was to find out if sugar ingestion prior to exercise is beneficial to an atheletic performance.

The glucose level in the blood has a direct correlation to how you feel and how much energy you have. Therefore, I ran a njmber of blood glucose tests after sugar ingestion with both exercise and without exercise in order to come to a conclusion whether sugar ingestion prior to exercise is beneficial to an atheletic performance or not . I tried to keep as many of the background variables as uniform as possible. However, such variables as stress and the amount of estrogen in the blood are some uncontrollable variables that could have an effect on the blood glucose level.

From this experiment I found that when sugar in ingested prior to exercise it sometimes makes the blood glucose oscillations go higher and lower with exercise. Therefore, I am able to conclude that since the level of glucose in the blood drops really low after sugar ingestion and exercise this low level in the blood glucose may prevent an athelete from obtaining that athelete's maximal sports performance. Therefore, sugar is probably not a very beneficial thing to eat before an atheletic performance.

* FIBER: HOW IT AFFECTS CONTROL IN TYPE I DIABETES

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PROBLEM: Does the addition of more fiber to the diet of a diabetic affect control, and if so, in what way?
HYPOTHESIS: The addition of more fiber to the diet of a Type I diabetic affects blood sugar levels, and also levels of insulin needed.
PROCEDURE: I calculated low and high fiber diets, and the levels of fiber in each diet. I researched fiber, and calculated amounts of soluble and insoluble fiber in each diet. I followed my regular diet for one week, and then followed the low and high fiber diets for one week each. I recorded blood sugar levels and amounts of insulin during those three weeks. I kept levels of exercise and insulin constant so that blood sugar levels would be comparable. I did all testing with an Accu-chek blood Glucose Monitor and Chemstrip bg test strips. The blood was drawn by means of capillary blood letting.
RESULTS: Blood sugar levels were lower when I was following the low and high fiber diets. Insulin needs also went down , as a result of a lower calorie intake. This was a result of feeling full faster because the more fibrous foods are more filling. My weight went down about 6 pounds because of the lower amounts of fat in the diets.
CONCLUSION: Fiber is beneficial to Type I diabetics, because it helps to lower blood sugar levels, and to lessen insulin needs. Therefore, it is also a factor in a weight-loss program. A diet which contains 20 to 25 g of fiber per day is the best in controlling blood sugar. Soluble fiber, as is found in citrus fruits and oat bran, is the major factor in lowering blood sugar, because it increases the number of metocytes in the blood stream. Metocytes are the blood cells which act as insulin receptors, therefore increasing the availability of insulin to more of the blood.

***Honorable Mention - Federal Aviation Administration**

CHOLESTEROL A CORONARY CULPRIT

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The purpose of this study was to find the effects of exercise on the cholesterol level in humans and also to determine if diet, heredity, age, weight, and daily activity effect the cholesterol level or the high density lipoprotein level. Through laboratory research I tested thirteen people ranging from the age of 13 to 81 to find their cholesterol level. I had each person increase their exercise for thirty days in a way that would be appropriate for their age, weight, and in relation to their past activity. Each person kept records on time spent exercising. I retested the thirteen people at the end of the thirty days to find how much the exercise effected the cholesterol level. Each participant completed a survey on factors that could effect their cholesterol. An additional high density lipoprotein test was processed on each person's blood. Contrary to what was first believed, this study revealed that exercise alone for 30 days is not enough to lower the cholesterol level in humans. In fact some participants cholesterol levels actually elevated slightly after being involved in 30 days of increased exercise. Other factors that need to be considered in how cholesterol levels are effected are: age, weight, heredity, diet, and activity level. I also found that some may have a high cholesterol level, but may also have a healthy high density lipoprotein level.

B-GALACTOSIDE SPECIFIC LECTIN ON SELECTED VASCULAR CELLS

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An investigation was conducted to examine the influence peanut (*Arachis hypogaea*) lectin on the rate of 3T3 fibroblast,smooth muscle cells (SMC)Phase I, and Bovine aortic endothelial cells (BAEC)Phase II, proliferation when grown on different matrices. Peanut lectin was added to 3T3 cells, SMC and BAEC at $7\mu g$/ml. On Collagen I, the control 3T3 fibroblasts growth peaked on day 1 and decreased steadily on days 3 and6. Experimental cells increased steadily from days 1 to 10. On Collagen IV, control and experimental peaked on day 1 and decreased by 18% on day3. SMC in the experimental group increased steadily until day 4 and decreased 10% on day 6. The cells without lectin peaked on day 1 and plateaued at days 4and 6. Peanut lectin increased the growth of SMC and 3T3 fibroblast depending on the matrix. On Collagen IV, BAEC cultured in serumless medium,proliferation was stimulated by lectin. In the presence of serum, there was not a significant difference in the growth BAEC with or without lectin. Within the rat lung, when galaptin activity is inhibited by Dexamethasone (synthetic gluccorticoid), alveoli are abnormally formed. Since lectin stimulated 3T3 fibroblast growth, this suggest that abnormally formed alveoli could be attributed to low lectin levels. When reendothelialization is delayed or insufficient, fibrocellular intimal thickening occurs, which is the basis for atherosclerosis. Lectin has proven mitogenic toward BAEC ; it may enhance reendothelialization and aid in possibly cutting down on atherosclerosis.

EFFECTS OF NUTRITION ON COMPENSATORY RENAL GROWTH AND FUNCTION

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Compensatory growth of the kidney is essential when a person loses kidney tissue or receives a kidney transplant. The stimulus for compensatory kidney growth is loss of kidney tissue. Several factors, including nutrition, may hinder or enhance compensatory kidney growth. During the past two years, I have found that the magnitude of compensatory kidney growth was directly proportional to the amount of protein in the diet. Of equal importance, I found that a decrease in caloric intake, despite increased protein, severely compromised compensatory kidney growth. In addition, I found that a high quality protein diet produced more compensatory kidney growth and ultimately on kidney function. My results demonstrate that increasing the rate of essential aminoacids to non-essentaial aminoacids enhances the magnitude of compensatory kidney growth following unilateral nephrectomy in Sprague-Dawley rats. Kidney functional efficiency was maintained when expressed as creatinine clearance in cc/min/gm of kidney weight; and the calculated creatinine clearance increased in direct proportion to the percent increase in compensatory renal growth.

#First Award - American Medical Association
Third Award - ISEF/Medicine and Health

* IMMUNOLOGIC REACTIONS CONCERNING ANTIBODIES AND ANTI-IDIOTYPES WITH APPLIED STATISTICAL ANALYSIS

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This study applied anti-idiotypes in two animal model groups. The first group being cattle, with the respective study designed to deal with the production and evaluation of an anti-idiotypic vaccine for *Brucella abortus*, a contagious disease in cattle. The second being chickens, with the respective study designed to deal with fat modification using anti-fat cells serum and an anti-idiotypic vaccine.

Statistical analysis was applied by the researcher to the results of this study.

It was hypothesized that the techniques applied here will in fact produce the desired results.

The methods used to produce both anti-idiotypes are as follows: 1) Inject and animal (A1) with the "antigen". 2) Extract the antibody from the A1 serum. 3) Emulisfy the antibody and inject into a second animal (A2). 4) Extract the anti-antibody (also termed anti-idiotype) from the A2 serum. 5) Inject the animal for which the anti-idiotype was made.

Results are as follows: 1) There was a 66.7% success rate achieved with the *Brucella abortus* anti-idiotype. Commercial Strain 19 achieves 65%. 2) There was a density difference between the experimental and control groups of the vaccinated chickens. However, it was proven that these differences were not statistically significant. (It is felt that this situation could be remedied by greater hyperimmunization of the vaccine producing animals, diet modification and/or an increased concentration of the anti-idiotype vaccines.)

Discussion may be based on design imperfections and the modification of experimental design.

In conclusion, anti-idiotypes have great potential in today's ever advancing soceity.

*Third Award - ISEF/Medicine and Health

THE CHELATION CONTROVERSY

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An EDTA Solution will bind with calcium in arterial plaque. It will therefore have a greater light absorption as measured by a spectrophotometer. Fat and pure cholesterol should not have a significant change since EDTA does not bind with carbon, hydrogen, and oxygen - the only components of these two materials.

Fat and arterial plaque were obtained through dissection of a cow heart. Arterial plaque, fat, and pure cholesterol were each added to distilled water and an EDTA solution. They were left for two days to react. Then each was tested in a spectrophotometer for light absorption. The results were compared to the light absorption of distilled water. The fat/EDTA solution absorbed more light than the fat/water solution. Both the plaque/EDTA and the pure cholesterol/EDTA solutions absorbed less light than the plaque/water and pure cholesterol/water solutions. A second experiment was done treating arterial plaque with EDTA and then washing it. Both this plaque and fresh plaque, untreated with EDTA, were homogenized and centrifuged. A clinic took the supernatant and read for total calcium in the solution.

Since the plaque absorbed less light in the EDTA solution, it is concluded that the EDTA did not bind with the calcium in the plaque. This disproves chelation theory. If the EDTA did bind with part of the plaque, a greater amount of light would have been absorbed by the larger molecule. The pure cholesterol, as expected, had no significant change.

CAN SPERMICIDES CAUSE MUTATIONS OR BIRTH DEFECTS?

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The eggs of *Drosophila melanogaster* were laid and the larva raised in media containing 10%., 1.0%, 0.1%, and 0.01% concentrations of nonoxynol, the active ingredient in contraceptive spermicides, to determine if spermicides could cause abnormal development or mutations. Development in the 10% concentrations was arrested in the larval and pupal stages of development and no adults were hatched. The concentrations of 1.0%, 0.1% and 0.01% all had F-1's hatch. Each concentration had significantly higher numbers of flies with abnormal development than the control flies. The F-1 flies were placed in new vials of media to produce an F-2 generation of flies. The absence of observable mutations in the F-2 generation would indicate that nonoxynol probably interferes with morphogenesis rather than causing mutations.

#Third Award - ISEF/Medicine and Health

Ethnomedical Plants of Puerto Ricofor the treatment of *Schistosoma mansoni*

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In this work we investigated the action of some plant extracts on the oviposition of *Schistosoma mansoni*. A group of mice were infected with approximately 150 cercariae by tail exposure. Three and a half months later, infected mice were treated for 10 days with a combination of plant extracts. Extracts were combined according to proportions and concentrations suggested by country people. Instead of tea, this part was investigated in the first fase of the work. In the second fase we made capsules using active ingredients from ethnomedical plants and gelatin combined with the same proportions according to the suggestions of country people. By the end of the treatment the reduction of eggs per grams was of ninety percent (90%) and there was an in the number of inmature eggs. Results indicate that eggs per gram counts were reduced three folds, four days post infection. A slight increase was seen 6 days after infection. This new drug is easy to produce in developing countries

ANABOLIC STEROIDS AND THEIR EFFECTS OF TISSUE DEVELOPMENT

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With the emphasis on strength and fitness in today's society, people have become aware of ways to achieve results faster and perhaps greater through the use of steroids. However, science has shown that these drugs can cause serious harm to the user. Nevertheless, in their quest for the perfect body, many people, especially bodybuilders, acquire these drugs illegally to achieve the optimum.

Because of the emphasis on the use of steroids, I decided to approach my study in two ways. First, to see if and to what extent steroids were being used in my community by conducting a survey at local gymnasiums which pertained to the public's awareness of the effects of steroid use and the percentage of athletes actually using the drug. Second, to show by scientific process what effects steroids can have on epithelial and fibroblast frog cell cultures by injecting the cells with anabolic steroids (Deca-Durabolin). Although this does not show the distinction of human tissues, the results are representative of the seriousness of the damage to the tissues tested.

THE IMMEDIATE EFFECTS OF EXERCISE ON COGNITIVE PERFORMANCE

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Most research in the past dealing with exercise and cognitive performance has focused on the long-term effects. Experiments dealing with the immediate effects have shown inconsistent results. I hypothesize that moderate aerobic exercise immediately before mental work and at intervals can improve cognitive performance in humans.

The subjects of my experiment, 41 high school and college students, are representative of a population frequently subjected to lengthy standardized tests. I designed a counterbalanced experiment so that each subject participated in an "exercise" and "no exercise" testing session in a random order. The subjects were randomly divided into five groups to lessen the impact of any extranneous variables. The variables I used are as follows:

*experimental independent variable—exercise before tests and at intervals,
*correlational independent variable—exercise attitude scores,
*dependent variables—math & verbal scores, alertness/confidence scores.

I designed all tests and questionnaires myself. The sessions were conducted as follows: 5 min.-sitting & conversation OR exercise, 15 min.-math test, 5 min.-sitting & conversation OR exercise, 15 min.-verbal test, final questionnaires.

The only statistically significant finding was an improvement in math scores with exercise. Existing theories suggest that the improvement was due to arousal of the central nervous system and increased blood flow to the cerebral cortex. This research could be applied in schools, industry, or by individuals. Continuation possibilities include replication with only math and experimenting with different intensities of exercise.

#Second Award - Federal Aviation Administration

IMMUNOLOGICAL STUDY OF IBR AND BVD IN NEONATAL CALVES

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The objective of this research was to determine the age at which neonatal calves lose the immunity to Infectious Bovine Rhinotracheitis (IBR) and Bovine Viral Diarrhea (BVD) that they receive from their mother. It was hypothesized that this immunity would last from four to six months after parturition.

Blood samples were collected at forty-eight hours after birth and every two weeks thereafter from neonatal Holstein calves. The serum was separated from the cells and stored at -30°C for three to four days. Then, each control and test plate was checked on two successive days for cytopathic effect (CPE).

It was found that two calves had no immunity to BVD, two calves exhibited CPE on all samples for the first time at eight weeks of age, immunity was lost at twelve weeks in one calf, and one calf had no more immunity at fourteen weeks. Two other calves have not yet reached the point of no immunity. Only one calf exhibited immunity to IBR.

The data indicated that there was a great deal of variation among the calves. It can be concluded that immunity levels in a neonatal calf depend a great deal on the amount of immunity present in the calf's dam. The average age at which a calf was no longer immune to BVD was 2.6 months; this data did not support the original hypothesis. This could suggest that immunity levels might be low in the mother, or that the average calf did not ingest enough quality colostrum to give it a high level of protection. Because only one calf was immune to IBR, it is evident that vaccinating the dam does not always protect the offspring.

FURTHER STUDIES OF ARCHAS ZAPOTA EXTRACT A IN VIVO AND IN VITRO ANTINEOPLASTIC ACTIVITY A BIOMEDICAL AND BIOCHEMICAL APPROACH

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This research originated from the use of *A.zapota* in Puerto Rican folklore in the treatment of ulcers (Nuñez,1981).The main objetive was to study the pharmacological possibilities of extract.The antineoplastic effect of extract were studied on Balb/C mice on EHS Sarcoma and compared with MTX. TGC studies showed 86% of reduction when using *A.zapota* and 99% when using MTX. No death was observed.Acute and chronic toxicological studies were obtained from the library research.*A.zapota* has low toxicity (eg.LD 100-85%).Cardiovascular evaluation(EKG), Open-field behavior and Teratological assay of nine mating situation(external, *post mortem* X-Ray). The results reiterated *A.zapota* low toxicity however, a increased locomotive activity, were observed,adverse cardiovascular effects in MTX group.This accordance with previous report of MTX high toxicity.

Biologically, many antineoplastic agents have become useful in the control of bacteria(Burchall,1971).The test were:MIC, sensibility, and metabolism with four sugars.These tests concluded that *A.zapota* a good antibacterial agent for Gram-pos. bacterium(eg *E.coli*).

Biochemical analyses, based on the generation of density gradients of phase separation.TLC determined;fructose 1.38,glucose 3.37,sucrose 16.13. Also by other method obtained;Ph=5.35,Tannins 29.61 MG/100gr., Total acidity .26, Soluble Solids 20.2, Total Solids 24.07 and Ascorbic acid is negligible. The studies will help to elucidate the phytochemical basis of its antineoplastic and antibacterial activity. Similary a histopathological examination of EHS Sarcoma tumural tissues is still underway. These analyses will provide some information of the *in situ* action at the celular level and also complete de in vitro phase of the research. The high content of sugar in the extract of *Archas zapota* is the component that demostrated the high activity.

It is anticipated that further studies about *Archas zapota* may provide the basic of a new very promising antineoplastic and antibacterial agent.

EFFECTS OF CHRONIC EXPOSURE TO COLD ON ADRENERGIC FUNCTION IN *RATTUS NORVEGICUS* - A NEW ANIMAL MODEL FOR STUDY OF HYPERTENSION

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HYPERTENSION IS A SIGNIFICANT HEALTH PROBLEM IN THE USA, TODAY. THERE ARE TWO TYPES OF HYPERTENSION. THE FIRST IS PRIMARY OR ESSENTIALY HYPERTENSION, WHICH IS A COMPLEX, MULTIFACTORIAL DISEASE WHOSE CAUSE IS UNDETERMINED. THE SECOND IS SECONDARY HYPERTENSION, IN WHICH THE UNDERLYING CAUSE IS KNOWN. CURRENT LABORATORY MODELS ONLY EMULATE A SELECT ASPECT OF ESSENTIAL HYPERTENSION, AND OFTEN REQUIRE RADICAL SURGICAL PROCEDURES OR EXTREME DOSAGE OF DRUGS. IN LIGHT OF THIS, AN ENVIRONMENTAL MODEL WAS DESIGNED i.e. HYPERTENSION INDUCED BY CHRONIC EXPOSURE TO COLD. THE PURPOSE OF THIS PROJECT WAS TO EXAMINE CHANGES IN THE CENTRAL AND PERIPHERAL NERVOUS SYSTEMS, INDUCED BY CHRONIC EXPOSURE TO COLD. IT WAS HYPOTHESIZED THAT CHRONIC EXPOSURE TO COLD WOULD RESULT IN A SUSTAINED ELEVATION OF MEAN, SYSTOLIC BLOOD PRESSURES. THE STUDY POPULATION CONSISTED OF 43 WHITE RATS, EACH CANNULATED WITH A CATHETER IN THE CAROTID ARTERY. THEY WERE DIVIDED INTO THE CONTROL GROUP (6 RATS KEPT AT A CONSTANT ROOM TEMP. OF 26 + 2 C). VARIOUS PARAMETERS WERE ANALYZED AND THE RATS WERE SACRIFICED AT PREDETERMINED TIMES DURING THE RESEARCH. CONCLUSIONS: ALL EXPERIMENTAL RATS DEVELOPED HYPERTENSION AND SHOWED INCREASE IN THE SIZE OF "TARGET" ORGANS (HEART AND ADRENALS). THIS ENVIRONMENTAL MODEL APPEARS TO BE EFFECTIVE IN THE STUDY OF PRIMARY HYPERTENSION.

AN ANTIGEN INVOLVED IN THE DESTRUCTION OF ENDOCRINE TISSUES.

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Both Diabetes mellitus Type I and Addison's Disease are caused by the hyposecretion of hormones. Type I Diabetes results from the lack of insulin, while the lack of glucocortiocoids causes Addison's Disease. It has been shown that the hyposecretion of the hormones is caused by the destruction of endocrine tissues specifically the Islets of Langerhans in the pancreas and cells in the adrenal cortex. It is believed that an autoimmune response destroys these tissues. The immune system produces specific antibodies against these tissues. The antigen to which the antibodies are being produced is unknown. The purpose of this investigation was the characterization of this antigen. It was thought that the antigen is a ganglioside, a lipid containing sialic acid.

Biochemical manipulations using pancreas, adrenal, and brain tissues were performed for the initial characterization of the antigen. Absorption assays using pancreas, adrenal, and brain lipid extracts were performed to categorize the antigen as a non-polar or polar lipid.

After reviewing the data from this investigation two possibilities concerning the nature of the antigen have arisen. One is that the antigen is not a lipid, another is that more then one antigen is being expressed.

*Second Award - ISEF/Medicine and Health

# IN VITRO GROWTH REQUIREMENTS, CELL SENESCENCE, AND ALTERED DNA CONTENT OF HUMAN AMNIOCYTES

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Normal, non-cancerous cells will age or senesce in culture, showing a change in growth rate and morphology. The purpose of this study was to examine the process of aging in human amniocytes. Amniocytes were obtained from a clinical lab and grown in Ham's F-10 medium with 16% fetal bovine serum, using basic asceptic tissue culture technique. Cell growth was quantitated at each subculture using a Coulter Counter. Cell samples were fixed in ethanol, stained with propidium iodide, and then analyzed by Flow Cytometry to determine cellular DNA content.

Amniocytes from different patients varied widely in the number of population doublings obtained before senescence. The results also indicated that senescence in human amniocytes is accompanied by a change in average DNA content per cell and an increase in cellular heterogeneity.

One strain of amniocytes was utilized to determine whether serum in the culture medium could be at least partially replaced by other growth factors. Cells were grown in medium containing 16%, 8%, 4% or 0% serum with or without addition of insulin, transferrin, and selenium (ITS). Statistical analysis indicated that the cells grew as well in media with only 4% serum as with 16% serum; there was no growth in the absence of serum. ITS stimulated the rate of growth and also increased the life-span of the amniocytes.

These experiments indicate that amniocytes are a good model for studying the effects of growth factors on aging in human cells.

*First Award - Tissue Culture Association
Second Award - ISEF/Medicine and Health

ASPIRIN, CHOLESTEROL, AND ATHEROSCLEROTIC FACTORS

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Aspirin decreases risk of CHD, partly by discouraging thrombus formation. High serum cholesterol levels are associated with high risk of CHD, probably because cholesterol accumulates in atherosclerotic lesions, but all of the modes of action of aspirin and cholesterol on CHD are not known.

Their effects may be related. Hyperlipoproteinemia is associated with hyper-active platelets, and aspirin may discourage lipid accumulation in blood vessels. (Boerboom 86) They could also alter the intestinal flora and the breakdown of atherosclerosis-related factors.

My research involved four groups of mice. One received aspirin, one extra cholesterol, and one aspirin and extra cholesterol. I tested the effects on the digestion of atherosclerosis related factors.

As hypothesized, both the cholesterol and the aspirin altered the fecal bacteria counts. These changes could account for some of the other changes produced. Cholesterol increased food passage time, salt retention, serum cholesterol levels and LDL/HDL ratios and decreased fat retention. Aspirin decreased food passage time and LDL/HDL ratios and increased fecal pH and salt retention.

These alterations produced on atherosclerotic factors could be related to aspirin and cholesterol's modes of action of in altering risk of CHD.

#Fourth Award - ISEF/Medicine and Health

#INHIBITION OF F-9 CALICIVIRUS PRODUCTION BY VIRAL-INDUCED FELINE KIDNEY INTERFERON

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The antiviral agent on which interest is currently focused most intensely is one that is elaborated by living cells themselves. Most animal cells infected with viruses produce a protein, interferon (IFN) which, when added to uninfected cells, protects them against virus infection. Cell cultures are ideal for IFN research because of the environmental control and economy. Cultures may be exposed to IFN at a lower and defined concentration with direct access to the cell. To study the anti-viral effects of IFN, I have induced the production of and characterized IFN in feline kidney cells by infection with Feline Calicivirus (FCV-9). To quantitate the effects of these IFN samples on virus production, I have adapted a microtiter assay for IFN which provides an economical, simple, and sensitive IFN assay for routine use. The procedure consists of culturing cells in 96-well microtiter plates, exposure to IFN dilutions, challenge with FCV-9, and staining with crystal violet. The bound dye is then eluted and absorbance measured in an ELISA Reader. IFN provided a protective effect against FCV-9 infection decreasing in effectiveness as treatments became more dilute. The amount of time post-infection before IFN samples were collected also affected the amount of protection afforded. Samples taken 12 hours after inoculation had the highest IFN titer and proved to be most inhibitory to viral production. It was concluded that IFN can be induced in vitro, and does inhibit FCV-9 production in feline kidney cells.

#Fourth Award - ISEF/Medicine and Health

MORPHOLOGICAL EFFECTS OF SUGAR SUBSTITUTES ON THE EARLY DEVELOPMENT OF GALLUS DOMESTICUS: A FOURTH-YEAR STUDY

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The purpose of this fourth-year study of sugar substitutes was to investigate the morphological effects of sugar substitutes on the early development of chicks. Four phases of study included: I. Effects of sugar substitutes on the heart rate of embryos; II. Extended study to include fructose and starch for comparisons to substitutes and sucrose. III. Morphological effects of phenylalanine, aspartic acid, and methyl alcohol on the embryos, and IV. Possible identification of morphological effects of sugar substitutes on the early development of two-week old chicks. Procedures used in Phases I, II, and III included surgically cutting shell windows on each fertile egg as implants were made on the chorio-allantoic membrane. FDA standards of 50 mg per kg of body weight were used. Combination dosage was doubled--2 tsp. Phase IV allowed the researcher to inject two-week old chicks with concentrated sugar substitute solutions. With the supervision of a veternarian, the chicks were euthanized with phenyl barbitol and a gross necrology was conducted. Results in phase 1 and 2 showed that saccharin and aspartame decreased the heart rates. Sucrose and fructose increased the heart rates. The control (saline sol.) has no effect. Phase 3 injections of 25 mg. 50 mg., and 100 mg. showed definite changes of embryonic growth patterns. The larger dose produced smaller and lighter weight chick embryos. Phase 4--the gross necropsy could only allow for student suppositions, since the only visible effects were fatty livers. Although chicken livers are often normally fatty, such could also indicate disease. The student researcher would like to consider histopathology in another project year. Extensive reading/research was completed by the student. Related literature on the use of aspartame for human consumption is still a question!

* A LOW CHOLESTEROL EGG: A NECESSITY FOR FUTURE DIETS

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The purpose of this project was to test to see if cholesterol could be lowered in chicken eggs by supplementing the chickens' feed. Cholesterol is a fatty acid that in large doses causes hardening of the arteries and may ultimately lead to heart attack or stroke. One major source is eggs.

Three feed supplements were separately introduced into the diet of Hall's Golden Cross hens for a two week period and the cholesterol level in the egg yolk measured. The first feed supplement chosen was oyster shells, commonly fed to increase shell density. The second supplement, sunflower seed, is used by poultry farmers to make both a healthier and heavier bird. After a two week feeding period a Monarch Analysis showed that either of these two supplements lowered egg yolk cholesterol content by approximately 30%.

A third supplement, *Brassica Oleracea*, (cabbage) was tested because it contains a mixed function oxadase, that when it comes in contact with cytochrome, P-450, in the liver induces it to lower the rate of cholesterol synthesis. The result from a Monarch Analysis showed that the egg yolk cholesterol content was lowered by an impressive 47%. Because this was done naturally, it had no adverse effect on the chickens' weight, the egg weight, or the egg production.

*First Award - American Medical Association

The Effect of a Simulated Body Solution on Different Orthopeadic Implants

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One of the greatest problems that arises from total hip replacement operations is the corrosion of the metals in the prosthesis. After implantation in the body, the prosthesis is subject to slight electric current and the saline conditions of the surrounding body tissues. These conditions lead to the galvanic corrosion of the prosthesis. This corrosion can cause infection of the operative area, incorrect function of the prosthesis, and the need for second and third operations. For these reasons, it is necessary to ascertain which prosthesis is most resistant to galvanic corrosion in the human body.

The investigation was performed on the three most common hip implants on the market today: Zimaloy (a brand name for castchromium molybdenum), Stainless Steel, and Titanium. Each implant was subject to an simulated in vitro environment of a 99.1% water, .9% sodium chloride solution supplied with a twelve volt electric current. The solution simulates activity within hip tissues, and the twelve volt current, which is considerably higher than the average .2 volts in the human body, allows the experiment to simulate long periods of time. Each trial of ten hours simulate long periods of time. Determination of the prostheses' resistance to corrosion was measured by massing the prostheses at each time interval and calculating the percentage mass change.

In all ten trials, the Titanium prosthesis had the highest percentage retention of its original mass. Stainless Steel tested slightly better than Zimaloy over the ten trials. These results have strong implications to the medical community. The data suggests that the Titanium prosthesis would be more beneficial for use in total hip surgery because of its higher corrosion resistance.

#"ANTIBIOTIC RESIDUE FOLLOWING INTRAMAMMARY INFUSION FOR THE TREATMENT OF MASTITIS"

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The dairy cow is the leading producer of fluid milk in the United States. Of primary importance is the mammary system because it produces milk. Bacteria or pathogens that enter the udder through the teat causes a condition known as mastitis. Mastitis costs the nation's dairy industry over $2 billion annually because of lower production, discarded milk, and treatment costs.

Mastitis is divided into two groups, clinical and subclinical. Clinical mastitis can usually be seen by the eye and is readily detectable by the dairyman. Subclinical mastitis requires laboratory diagnosis and usually shows no outwardly physical signs as does clinical mastitis.

Mastitis is usually treated with an antibiotic given by intravenous, intramuscular, intrauterine, or intramammary methods. Intramammary infusions into the infected quarter are the most widely used method used to treat clinical mastitis. Every antibiotic treatment has a recommended withdrawal or discard time that the milk from the treated animal cannot be used for human consumption. It is illegal for the dairy farmer to ship milk to the processing plant that contains antibiotics above an acceptable level.

It is the purpose of this research to determine if the treated quarter would retain antibiotics longer and how much longer. The Charm Cowside Test and the Delvotest-P were used to test milk from each quarter at 24 hour intervals. The results of my research revealed that milk from the infused quarter did retain the greatest amounts of antibiotics and for a longer period of time than the untreated quarters.

#First Award - American Veterinary Medical Association
Third Award - ISEF/Medicine and Health

WHAT'S YOUR EYE-Q? A SIX YEAR STUDY

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What's Your Eye-Q? is a six year science fair project studying whether computers can aid in the testing of eyesight and hearing. "Eye-Q" is my coined word which relates to the ability of seeing an item and then understanding and performing an action. Another objective of the project is to determine trends in vision and hearing as a function of age.

In 1988, the abilities of the Amiga computer were used to develop a test of depth perception. This test was attempted in 1986 on the Commodore 64 but was not successful. In addition to the depth perception test using red and green glasses on the Amiga, studies were done on three-dimensional effects using holograms and glasses with different polarization filters.

The procedure for evaluating the above hypotheses were the following nine experiments: Basic Reaction Time; Color Dot Perception; Visual Acuity; Amsler Grid Test for Macular Degeneration; Astigmatism; Persistence of Vision; Color Blindness; Hearing and Depth Perception. Eight tests were designed around the three major actions associated with eyesight which are the ability to see, the brain recognizing what is seen, and then the hand, etc. taking the necessary action on what is perceived.

The results verify the hypotheses that eyesight, perception and hearing, in general, decline with age and that computers are excellent labor-saving devices for this evaluation. Computers and expert system software (artificial intelligence) are developing into a cost-effective system for evaluating eyesight, perception, and hearing.

*First Award - American Optometric Association and Auxiliary to the American Optometric Association
Third Award - ISEF/Medicine and Health

SPERM SURFACE GLYCOPROTEINS: CAPACITATION AND ACROSOME REACTION

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Today molecular studies of the sperm surface are of major interest to ongoing fertility and infertility research. This study uses lectin probes to determine alterations in mouse sperm surface glycoproteins during the maturational process of sperm capacitation and subsequent to the acrosome reaction. In addition, lectin probes were used to identify a sperm surface glycoprotein which may mediate a critical stage in the process of fertilization known as the acrosome reaction.

The thirteen lectins used showed a distinct binding pattern before and after capacitation, and subsequent to the acrosome reaction. After capacitation, a migration or rearrangement of sperm surface glycoproteins was seen to the equatorial segment. This was most likely in preparation for the acrosome reaction. After the induction of the acrosome reaction, the majority of glycoproteins on the acrosomal cap were either lost or redistributed along the equatorial segment. Three of the lectins tested (PNA, Con A, WGA) proved successful in inhibiting the acrosome reaction. Cross-linking of surface components or binding to neighboring molecules on the sperm surface may be responsible for the inhibition observed.

*Fourth Award - ISEF/Medicine and Health

*MECHANISM OF THERMAL STABILIZATION IN THE ANTERIOR CHAMBER OF THE VERTEBRATES' EYE

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The main purpose of this investigation were: To determine how low temperature applied to cornea affects the anterior segment of the eye, To determine the possible existence of a mechanism of thermoregulation and to define local mechanism of heat transfer.

Preliminary antomical dissection with preserved cats of the eye, orbital region and neck were made in order to develope surgical approaches. Cats were anesthetized with Ketamine. Thermocouples were placed at iridocorneal angle, retina, conjunctiva, retrobulbar space and rectum. Cooling was effected by an air stream and a rubber bulb. Temperatures were measured every 2 minutes. Cooling was carried down to 8°C. I was an assistant, responsible of observing and recording data.

Anterior chamber stabilizes at 23.8°C, below this temperature pupillary paralysis occurs. Retina stabilzes at 28°C, down this temperature retina does not function. Application of topical anesthetic to cornea and conjuntiva, electrical stimulation of the cervical sympathetic chain and injection of vasoconstrictors result in temperature drop in the anterior chamber.

Thermal stability in the eye is assured by an extensive vascular heat exchange system, the presence of thermal receptors in the cornea and conjuctiva, and the protective mechanisms of the pupil. When this systems become inefficient or insufficient as may happen in very cold or very warm environments, pathological conditions may result, for example, snow blindness or pterygium.

The spontaneous paralysis of the pupil at relatively high temperature may be useful in selected ophthalmic surgical procedures.

*First Award - American Medical Association
Second Award - American Optometric Association and Auxiliary to the American Optometric Association
Fourth Award - ISEF/Medicine and Health

THE EFFECTS OF CHOLESTEROL ON THE HEART - A TWO YEAR STUDY

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I attempted in this two year research to prove that cholesterol has a perjorative effect on the heart. Two experiments were conducted. The first year's project was to prove the damaging effect of cholesterol on the heart. For this research I chose four rabbits, and each were placed on specific diets. Eggs were used as part of the diet to raise one rabbit's cholesterol level. This rabbit's cholesterol rose from 84 mg/dl to 1041 mg/dl while in contrast the rabbit's cholesterol on the low cholesterol diet never went above 136 mg/dl. The final results showed the heart of the rabbit on the high cholesterol diet to be substantially larger with visible signs of fatty tissue on the arteries. The rabbit on the normal diet exhibited a smaller yet healthier heart with no congestive blockage. The second year study was to establish the best way of lowering the body's total and LDL cholesterol. Again rabbits were used and eggs were a part of their diet to raise their cholesterol. After their levels were raised, I attempted to lower their cholesterol, one by diet while the other rabbit was given 20 mg daily of the new drug Lovastatin. The rabbit on the low cholesterol diet showed sudden drops in his level, while the rabbit receiving Lovastatin showed a steady yet controlled decrease in his cholesterol. During this two year study my research proved the danger of high cholesterol, however, it also proved cholesterol can be controlled by proper diet and medication.

THE EFFECTS OF HOLOTHURIN ON OVARIAN CANCER

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This project shows the effects of holothurin on ovarian cancer. Cancer of the ovary, a female reproductive organ, can cause irregularities in the menstrual cycle, and some of them produce hormones that give the patient increased female hormones or masculinizing characteristics. Holothurin is a saponin extracted from the sea-cucumber Actinopyga agassizi Selenka. Holothurin comes from the Cuverian organ and appears to have some antitumorous and other pharmacological properties. Holothurin has been proven effective to control Sarcoma 180 and Krebs-2 ascites tumor growth in mice.

In vitro studies were conducted in which different dosages, varying from 1 microgram to 2500 micrograms, of holothurin were administered to human and hamster tumors. The lower dosages, 1 to 125 micrograms, were ineffective in controlling the growth of the tumor, while dosages higher than 625 micrograms killed almost all the human and hamster cells. The effects of holothurin was similar on both the human and hamster cells.

Medical science has made use of the ocean's biological resources. Its useful products range from vitamins A and D provided by cod liver oil to poisons extracted from the stone fish. Cancer therapy can be aided by holothurin from sea-cucumbers.

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6 YEAR STUDY - EFFECTS OF ELECTRONIC GAMES ON HUMAN PHYSIOLOGY

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Approximately 40 people were tested each year for 6 years for: Blood Pressure, Pulse; Reaction Time, Eye-Hand Coordination; Galvanic Skin Resistance, External Body Temperature; Eye Focusing; Brain Waves; Plasma Catecholamines and Glucose levels. The same procedure was followed for five years except for time limits. First the subject would rest for a given amount of time. Games were played for the same amount of time. After playing, the subject was retested and compared for a difference, averaged, recorded, graphed and a conclusion drawn. Fifth year testing was done while playing the games. All tests were classified by the following age groups: 0-10, 11-15, 16-25, 26-35, 36-49, and 50 and over. My hypothesis was that video games will effect all age groups having a more negative effect on the body than a positive one. Based on my research, my conclusion is that playing electronic games has a negative effect on the human body in the following areas: It caused the pulse to rise, blood pressure to go up in most cases; stress, measured by Galvanic Skin Resistance, and external body temperature increased; prolonged playing caused eye fatigue as shown by the increased need in lens power to return to best vision. The only positive effects playing the games had on the human body was an improvement in reaction time and eye-hand coordination in most cases and an increase in brain wave activity. Some differences were found in Plasma Catecholamine and glucose levels. They were statistically analyzed.

#First Award - National Aeronautics and Space Administration
Second Award - ISEF/Medicine and Health

# WHAT EFFECT DOES STIMULATING PERIPHERAL VISION AREA HAVE ON MYOPIA?

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Research indicates that activities such as reading and needlepoint which use only the center of the eye may worsen myopia. A study done with Eskimos showed the younger generation of Eskimos who had learned to read had a higher incidence of myopia than the older, illiterate generation. Josh Wallman, project leader of research related to this topic, says: "Reading is a kind of mild deprivation of the retina mainly because the cells away from the center of the retina cannot distinguish between the little characters of the typical printed page." Reading deprives the outer part of the retina-the area responsible for peripheral vision. I formulated the hypothesis that stated the following: If the peripheral vision area of the eye is stimulated, then myopic vision will improve. To test this, I designed a device, a circular piece of oaktag with colors and letters along the edge and a paper fastener attached to a paper cup in the center. I identified 20 myopic individuals, tested their vision, and separated them into a control and experimental group. The individuals in the experimental group were instructed to focus on the paper fastener while slowly spinning the device 30 times while covering the right eye, and repeating with the left eye. This exercise was to be done on a daily basis for 30 days. At the end of 30 days, I retested the vision of all 20 individuals. From my results, I concluded that the vision of myopic individuals may benefit from performing exercises that stimulate peripheral vision. In the future, I would like to continue this experiment by using a larger group of people and allotting a longer period of time for doing the exercises.

#Honorable Mention - American Optometric Association and Auxiliary to the American Optometric Association
Honorable Mention - Optical Society of America

The Effects of Herbal Preparations on Cancer Cells: Immunotherapy or Chemotherapy?

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This research project studies the chemotheraputic effects of herbal preparations on cancer cells and normal cells as a control. It assays these herbal preparations to see if they inhibit the growth of cancer cells. The assay used involved counting the number of cells to determine the cell growth after 4-5 days. The other assay used was the DNA flurometric assay which was used to measure the growth of normal cells. The results show that three herbal preparations, Amrit Kalash, Ayurveda Bhasma Rasayana and Ginseng, inhibited the growth rate of U-937 cancer cells in vitro. This finding was statistically significant. Two very important factors in the experiment were the dilution or concentration of the herbal preparation used and whether the growth rate of the normal cells (peripheral blood lymphocytes) was suppressed. Amrit Kalash at higher dilutions inhibited cancer cell growth up to 53%, but did not inhibit normal cell growth. The Bhasma Rasayana at high concentrations inhibited cancer cell growth 30% without significantly inhibiting normal cells. Ginseng inhibited cancer cell growth and normal cell growth substantially at lower dilutions. The higher dilutions are closer to what a person would take in their diet therefore Amrit Kalash might have the greatest potential theraputic application. Amrit Kalash was also assayed in K-562 cancer cells, but found only to inhibit cell growth slightly. By inhibiting cancer cell growth and not having bad side effects these herbal preparations could prove to be useful in preventing and curing of cancer.

#Fourth Award - ISEF/Medicine and Health

PREVENTION OF BACTERIAL INFECTION DURING VETERINARY SURGERY THROUGH THE USE OF ANTISEPTICS

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The purpose of this project was to test the general effectiveness of surgical antiseptics against the natural flora of bacteria on the skin and hair of a canine. Three phases were included in the experiment. The first phase involved the inoculation of a diluted broth of bacteria into working strength antiseptic. Equal samples were taken of the resulting solution at intervals of 0.5 minutes, 1 minute, 1.5 minutes, 2 minutes, 2.5 minutes, 3 minutes, 3.5 minutes, 4 minutes, and 5 minutes and placed onto separate agar plates. These samples were grown overnight and colonies counted. The second phase was performed in the same way using the same antiseptics diluted down five times. Since two of the three disinfectants tested showed growth only around the edges where the solution of antiseptic had not been spread as thickly, Phase III was done to provide a comparison between the two. In this phase, undiluted broth was inoculated into working strength antiseptic and samples then removed at intervals of 1 minute, 3 minutes, 5 minutes, 10 minutes and 30 minutes (the wide margin of time because of the heavy concentrate of bacteria.)

This experiment showed that the antiseptic Nolvasan was the most effective of the three antiseptics tested, and the bacteria Staphylococcus was the most tolerant of the five bacteria tested. It also seems to show that antiseptics are not always foolproof, as none of these antiseptics were successful in killing all bacteria during all tests.

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* THE REACTION OF SENSORY RECEPTORS TO NERVE INJURY

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The effects of nerve transection upon one sensory receptor, the Merkel cell present in the opossum's vibrissa, were studied. A proposed theory hypothesizes that Merkel cells are targets for regenerating nerves. If so, the population of Merkel cells before and after nerve cut should be related to the number of nerves reinnervating the area and could be used as an indicator for the ability of a single nerve and receptor to reconnect. There is controversy surrounding Merkel cell receptors. Some papers cite that they will disappear after nerve cut, others say there is no change, and still others say there is an initial decrease. This research will identify the reactions of this receptor to nerve transection. The left infraorbital nerve in the opossum (Monodelphis domesticus) was transected. The animals were given different post-operative survival time periods, terminated, and the tissue processed. Merkel cells within the opossum vibrissae were highlighted with a monoclonal antibody, using the ABC stain, and counted. Results show that there is an initial decrease in the Merkel cell population associated with denervation. The number of cells then increased in the same time frame as nerves reinnervated the area. Therefore, it seems most likely that Merkel cell integrity is dependent on nerves and that Merkel cells also function as target cells for regenerating nerves. The results of this research agree with studies that report Merkel cells initially decrease but do not disappear. Clinically, this research helps to explain why nerve-receptor reinnervation is possible; however, the nerve-receptor reconnection may be abnormal.

*Third Award - ISEF/Medicine and Health

#Cell Sensitivity Due to Clostridium Prefringens Delta-Toxin
Fernando Argeles
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Clostridium perferingens Delta-Toxin is a substance which identifies and attaches itself to cell surface features called gangliosides. After combining with the GM2 ganglioside the toxin then stops the sodium potassium pump and causes the particular cell to lyse. All of the previous work done on this toxin mainly dealt with the toxin's characterization and its affects on human neuroblastomas. This study concentrated on observeing the affects of the toxin on other types of human cancerous cells.

The cell sensitivity assay consisted of the following. Five different concentrations starting with 3 ug/ml and ending with .3 ng/ml (dilutions of ten) were created by placing the toxin in respective amounts of alpha mem. Each cell line was then placed in the concentration of 1,000,000 cells per 90 ul of alpha mem. Eighteen 90 ul cell samples (previous concentration) were then placed in a 98 well cell culture plate. To each sample, 10 ul of the respective Toxin concentration was added. The plate was incubated for a period of two hours, then the cells were stained with trypan blue and counted, thus finding the percentage of viability.

This research tested, among other cells, three types of human leukemic cells. The promylocytic leukemia, the T-cell leukemia, and the erythroleukemia cells all showed very similar sensitivity levels to all five concentrations of the toxin. This would indicate that leukemic cells have the ganglioside GM2 and that a possible treatment for leukemia might arise from the Delta-Toxin.

#Fourth Award - ISEF/Medicine and Health

FOWL OR FOUL? ARE YOU SAFE FROM SALMONELLA?
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Recently chicken has become a very popular food in the United States. This low-calorie source of protein can be prepared in many ways; however, the method of preparation is extremely important. The purpose of my project is to inform the public about salmonellosis, a disease caused by the presence of Salmonella bacteria in certain foods, including chicken.

Chicken can become contaminated by Salmonella at any point between the processing plant and the dinner table. My experiment deals with the improper preparation of chicken after it has been processed and sold. Using five different chickens as the basis for my experiment, I attempted to grow Salmonella under certain unsantitary conditions likely to exist in the consumer's kitchen.

In testing, Selenite Broth was the first medium used. The bacteria that grew in this was then transferred to Brilliant Green agar plates. The plates that tested positive, suggesting that Salmonella was present, underwent two more tests for verification, one of which was a Lysine Decarboxylase test. The bacteria reacted negatively or not at all to this test, and from these results I concluded that Salmonella was not present.

The number of chickens I tested represents only a minute portion of the total number consumed yearly in the United States. I was not successful in producing Salmonella, but that does not reduce anyone's risk of contracting salmonellosis. Everyone must be aware of this disease and take careful steps to prevent it now and in the future.

STATISTICAL AND CHROMOSOMAL STUDY IN VIVO AND IN VITRO OF CHEMICAL CONTRACEPTIVES AS MUTAGENIC AGENTS

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Ext. San Antonio St 7 N-38., Ponce, PR 00731

The principal objective of this research is to investigate whether the
spermicide "Delfen" and the contraceptives "Ovulen 28" and "Demulen"
cause chromosomal mutations and changes in DNA.
The methods included the preparation of chromosome's slides squashes and
the results were analized using the T test as a statistical study. In
the *in vitro* study the methods used were a chromosomal analysis of leu-
cocytes and fibroblast cells and sensitive test, Gram stain, MIC (E.
coli).
The results of the chromosomal studies with "Ovulen" revealed bent muta-
tions, localized in the chromosome 4 and aristaless antennae mutations.
The results with "Demulen" showed miniature and curved mutations. With
the spermicide "Delfen", the results revealed vestigial, and black body
mutations localized in the chromosome 2. A curious data was that all the
flies with mutations in the F_1 were females. Afterward, in later genera-
tions, both females and males flies with mutations were observed. With
the spermicide Delfen the mutations were more severe.
The statistical study showed that the spermicide "Delfen" and the con-
traceptive "Demulen" affected the female and male population density in
the same way; while the contraceptive "Ovulen" affected more the popu-
lation density of males.
The *in vitro* study is in process.
In summary, our results demonstrate that the spermicide "Delfen" and the
contraceptives "Ovulen" and "Demulen" affect the reproductive cycle,
cause a lower natality rate and mutations in the phenotype and genotype
of the fruit fly *D. melanogaster*.

#Fourth Award - ISEF/Medicine and Health

FREE RADICALS IN TISSUE INJURY

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PROBLEM: Does radical generation occur when heart muscle (myocardium) dysfunctions or when arteries become blocked, thus stopping the blood circulation completely for a very short period of time?
HYPOTHESIS: There should be direct evidence to support that reactive oxygen metabolites contribute to the dysfunction of the heart observed after brief ischemia (occlusion & reperfusion)(the stopping & starting of the blood circulation). Recent studies should suggest that oxy-radicals mediate the prolonged myocardial dysfunction, thus causing permanent or severe damage to the heart, eventually.
METHODS: 10 dogs were anaesthetized and put under a brief ischemia of a 15 minute coronary artery occlusion & reperfusion. Two groups were controlled and studied. Blood samples were taken out at separate times during occlusion & reperfusion. The blood was centrifuged and the plasma was frozen at -70° C. The plasma was then tested for spin adducts.
CONCLUSIONS: The EPR displayed that the peak of the radical was identified at 2 minutes after reperfusion for Group I and 4 minutes after reperfusion for Group II. This shows that regional myocardial ischemia in the intact animal is associated with prolonged free radical generation. This ischemia is a direct simulation to a heart attack (when the blood circulation stops and starts again). This then provides direct evidence to support the hypothesis that oxy-radicals contribute to the eventual damage of the heart itself, which could then conclude to death.

REGULATION OF T-LYMPHOCYTE GROWTH

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The regulation of Protein Kinase C (PKC) and Adenylate Cyclase (AC) was examined in Nb2 cells in order to determine whether these enzymes also play a role in Nb2 cell growth. Nb2 cells are rat T-lymphocyte cell line that proliferates in response to prolactin (PRL) and to interleukin-2 (IL-2). Normal T-lymphocytes also proliferate in response to IL-2 but not in response to PRL. Thus, it is likely that Nb2 cells have undergone some "change" that makes them responsive to PRL. Treatment of Nb2 cells with high levels of o-tetradecanoylphorbol 13-acetate (TPA), a procedure that has shown to down-regulate PKC in many cells, did not inhibit cell growth in response to PRL or IL-2. Furthermore, activation of PKC did not block the inhibition of Nb2 cell growth by prostaglandin E2 (PGE2), despite the fact that PGE2 is thought to act through activation of adenylate cyclase. These taken together suggest that PKC and/or AC are less important in Nb2 cells than in normal T-lymphocytes. The activity of AC was further examined using a specific radioimmunoassay (RIA) for cAMP. No cAMP was detected in unstimulated or stimulated Nb2 cells using this assay, although the assay was capable of measuring cAMP in a control T-lymphocyte cell line. These data suggested that Nb2 cells do not contain a functional AC. Consequently, suppression of AC may not be necessary for stimulating the growth of these cells. If PRL is an ineffective activator of PKC and thus a weak suppressor of AC, then the decrease of AC activity in Nb2 cells may be the "change" that allows PRL to stimulate growth. Moreover, the loss of an important inhibitory pathway such as adenylate cyclase may prove to be a key factor in the development of some leukemias.

#First Award - ISEF/Medicine and Health

COFFEE, TEA, AND ME

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The problem - Does 1, 3, 7,-Trimethylxanthine (caffeine) cause physiological modifications in homo sapiens? - was explored.

It was hypothesized that 1, 3, 7-Trimethylxanthine will cause physiological modifications in homo sapiens. The subjects' scores in testing reaction time, motor skills, memory, and comprehension will be better without caffeine in their system.

Each subject will consume two cups of caffeinated coffee and two cups of decaffeinated coffee at different times, therefore, the subject will be tested twice. The subject will not know if he consumed decaffeinated or caffeinated coffee. Each subject will then take part in a series of tests. Each test investigates the changes in physiological modifications with and without caffeine.

The results show that reaction time and motor skills improved with caffeine in the system. Memory and comprehension skills were weakened when caffeine was in the system.

The results help support the conclusion that 1, 3, 7, -Trimethylxanthine should not be consumed before studying or doing a similiar task, for it may hinder the memory or the comprehension of the subject. Caffeine, on the other hand, may help improve motor skills, such as typing. Caffeine may also help reaction time.

#First Award - Federal Aviation Administration
Honorable Mention - American Psychological Association

REVOLUTION IN MEDICINE: ANTIBACTERIAL AND FUNGICIDAL PROPERTIES DEVELOPED IN CLOTHES AS A CONTROL OF PATHOGENS

Rosa, Ruth M.
Adolfin Irizarry De puig, Toa Baja I, Puerto Rico
Bo. Pajaros Toa Baja, P. R.

In this research the following: Prove that a three percent solution of hydrogen peroxide with zinc oxide or acetyl salicylic impart antibacterial and fungicidal properties to diferent colors can retain this property in the fabrics tissues for a long time and after being washed. Fabrics treated with these solutions were put on areas of human skin which were inffected with the fungies Tinea pedis, Tinea corporis and Tinea Cruris for 5 (five) hours. It was found that these fungies species disappeared gradually. These fabrics were inoculated with pathogenic organisms mentioned. After 24 hours a swab was passed over the fabric samples and then these were streaked over culture media. After 24 or 48 hours incubation, the growth of the organisms was not observed. The same procedure was followed with bacterias. Other techniques used in the project were: place pieces of fabric directly over the different cultures; place 5mm parts of fabrics inside the culture immediately after the inoculation. After 24 or 48 hours of incubation the growth of the organisms was not observed. As for the result it can be concluded that the fabric incorporated hydrogen peroxide acquiring the property of immunity to bacterias and fungies. These solutions help to eliminated some skin fungies.

ARE SOLUBLE HUMAN LEUKOCYTE ANTIGENS PRESENT IN PLASMA?

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Kidney patients usually receive many blood transfusions before their actual transplant. During their blood transfusions they develop antibodies against blood donor's HLA antigens. When receiving a transplant only the HLA antigens on the cell surface are matched, while the HLA antigens in the plasma are ignored. This is why a perfectly matched kidney is sometimes rejected. To decrease the chance of rejection the HLA antigens in the plasma should also be matched.
To prove the presence of soluble HLA antigens requires the separation of A2 lymphocytes. Then A2 antibodies are added to A2 plasma in tray #1, while A2 antibodies are added to negative A2 plasma in tray #2 in varying ratios. The A2 lymphocytes which were separated are added to both trays whose viability determines the presence of antibodies. The A2 plasma neutralized the A2 antibodies at a lower ratio than the negative A2 plasma. Therefore, there are soluble HLA antigens in the plasma because the HLA A2 plasma neutralized the A2 antibodies.

THE DETECTION OF INTERFERON CONTAINING CELLS IN PRIMATE LYMPHOID ASSOCIATED TISSUE

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Previous studies have shown that interferon (IFN) gamma containing lymphocytes occur in vitro in response to antigen and mitogen stimulation and are detected in the peripheral blood of burn patients and some normal blood bank donors. Since the lymphatic system is the site of filtration of many antigens and the site of many immunologic reactions, monkey lymphoid associated tissue sections (lymph nodes, spleen, liver) were screened for the presence of IFN containing cells. IFN gamma containing cells were detected in the spleen and lymph node sections using an immunofluorescent antibody assay, while IFN alpha containing cells were detected in the lymph node sections only. Staining of IFN gamma containing cells was observed in areas throughout the spleen and lymph node sections. Thus, IFN containing cells can be induced under natural conditions in certain lymphoid tissues.

#First Award - ISEF/Medicine and Health

TOXIC SHOCK: THE INSIDE STORY

Theresa Ho
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The purpose of this project is to see how magnesium and estrogen affect the production of the toxin TSST-1. According to medical research, low concentrations of magnesium influence *S. aureus* to produce more protease while the body's low level of hormonal production during menstruation cannot inhibit much protease activity.

The first experiment involved the testing of the toxicity of the antigen, TSST-1, by using various levels of magnesium with *S. aureus*. Tampons were placed in four beakers, each containing 50 ml broth, various concentrations of magnesium, and 1 ml *S. aureus*. After incubation, a colony count was performed. Results showed that the control, with no magnesium, had 495 colonies while 1.5 mg/ml of magnesium had no growth. The toxicity of TSST-1 was tested by adding 30 ml of the solution to four *Carassius auratus*, each in separate containers. Breathing rates were determined and analyzed by using a t-test. Data was significant for the 1 mg/ml and 1.5 mg/ml of magnesium concentrations.

Next, protease was mixed with a protein solution and various magnesium amounts. Ninhydrin was used as an indicator for protein breakdown. Results show the control, which contained no magnesium, had faster protease action. In separate experiments estrogen was also added to a protein solution with protease. In every trial the protease with estrogen reacted faster. Thus, the conclusions concur with the role of magnesium but estrogen participation does not inhibit protease activity. Rather, it acts as a catalyst.

# DEVELOPMENT OF MONOCLONAL ANTIBODIES FOR THE DIAGNOSIS OF LEISHMANIASIS

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The goal of the project was to produce a monoclonal antibody specific to a pathogenic paramecium, *Leishmania major*, for use in diagnostic tests of persons suspected of infection with the parasite. Leishmaniasis, a disease which occurs mostly in the tropics, has outward manifestations which sometimes resemble other tropical diseases, making diagnosis difficult. Traditional diagnosis can take weeks, but diagnosis can be made in a matter of hours using monoclonal antibodies.

To produce the antibody, a Balb-c mouse was innoculated with fragmented parasite antigen until it exhibited a strong immune response. The mouse was sacrificed, and its antibody-producing splenocytes were removed and fused with malignant myeloma cells. The resulting hybrid cells (hybridomas) retained both the capacity to produce antibody and the ability to reproduce very quickly. There were a total of 128 hybridoma colonies, of which eight were found by enzyme-linked immunosorbent assay (ELISA) to be producing *Leishmania* specific antibody. Four of these eight antibodies exhibited strong reaction with *Leishmania major* in an immunofluorent assay (IFA). Two of these four exhibited strong exclusively *Leishmania* specificity by flow cytometry, one slightly more so than the other. A single hybrid of the culture producing the stronger antibody was cloned using limiting dilution in semi-solid agarose. Raw supernatant from the resulting culture of identical cells was shipped to an associate in Sudan where it is being used in diagnostic assays.

#Second Award - U.S. Air Force

\# THE EXTERNAL VALVULAR,NON-ATRICULAR,ARTIFICIAL HEART

Stuart L. Myers
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In my artificial heart, the Myers Experimental Artificial Heart, the atria and internal valves have been eliminated. This is accomplished by using two, external, pneumatically-driven,magnetic-piston valves. One of these valves is located between the aorta and pulmonary artery. The other is located between the pulmonary vein and the vena cava. In this heart,the superior and inferior vena cavae have been channeled into one common orifice. Likewise, the pulmonary veins have also been channeled into one common orifice. The valves alternately inflate, allowing for the input to be open while the output is open. Likewise, the input will be open while the output is closed. The blood is forced from the ventricles by a pneumatic diaphragm located at the bottom of each ventricle. When the diaphragm deflates, it creates a partial vacuum, which pulls blood into the ventricle. The ventricles are constructed from injection-molded polystryene coated in teflon. The diaphragms are constructed from two layers of teflon sheeting with a layer of latex sandwiched in between. The diaphragms are supported by a section of plexiglass which is coated in teflon teflon. Each valve consists of a section of aluminum tubing which is coated in teflon. Inside of this tube are the magnetic pistons, each coated in teflon. This device is powered by an air compressor.

\#First Award - Patent and Trademark Office/U.S. Department of Commerce/Patent and Trademark Office Society
Fourth Award - ISEF/Medicine and Health

MUSIC'S EFFECT ON BLOOD PRESSURE

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How does music affect blood pressure? The hypothesis assumed that different types and different preferences of music would affect one's blood pressure. The materials used for the experiment were a five-item questionnaire: a stethoscope: a cassette tape recorder: headphones: a blood pressure kit: and tapes of classical, pop, and hard rock music. The test subjects first completed a questionnaire to establish music preference, and then had their normal blood pressure measured. Then, three minutes of classical music was played through the headphones. The blood pressure was promptly measured following the three minutes of music. Pop and hard rock were then presented, and again blood pressure was measured in the same manner. Variables, such as volume, time of day and time and order of each song, were controlled as much as possible. Some variables, such as volume of the original studio recording, weather, and health of each participant could not be controlled. An analysis of the data revealed that music preference had only a slight effect on the blood pressure. As shown in graph 1, although the classical music produced the highest systolic pressure, the hard rock created the highest diastolic pressure. The results in graph 2 showed that the average systolic pressure was the highest in the pop music category, and the highest average diastolic pressure was observed in the no-preference group.

* LOCAL SCAR TISSUE PREVENTION (PHASE II): THE SEARCH FOR A BETTER SOLUTION

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The development of fibrous scar tissue is a result of the normal wound healing process. Although scar tissue is structurally able to replace destroyed tissue, it cannot perform the function of the missing tissue. This second year study continues the effort to locate a substance which will reduce post-operative scar tissue around the sciatic nerve in rodents. The successful pursuit of this topic could result in a tissue substitute for neurosurgery which would benefit the patient as well as aid the physician. The design of an original substance,ARGIN,and the implantation of 3 PTFE(polytetrafluoroethylene)compounds were used to insulate the sciatic nerve. In each of 25 male rats, divided into 5 equal Groups, using Halothane and .5cc Ketamine for anesthesia, the nerve was exposed, surrounding tissue irritated and materials implanted as follows:(Group V)Teflon Tape,(Group VI)GORE-TEX Vascular Graft,(Group VII)GORE-TEX Surgical Membrane/Silicone Gel Seal,(Group VIII)ARGIN/GORE-TEX Vascular Graft,(Group IX)GORE-TEX Surgical Membrane/GORE-TEX Sutures. The 1987 Group I Control served as the 1988 Control. Wounds were allowed to heal for 4-8 weeks;at regular intervals 1 rat from each Group was sacrificed by inhalation of Halothane.The nerve and surrounding tissue were removed and prepared for histological comparison of scar tissue. In general,the materials designed and selected for this year's study were more effective in reducing post-operative scar tissue than Mineral Oil, Liquid Silicone and Silicone Gel used last year.The 1988 materials proved to be chemically inert,were able to maintain their position around the nerve,and created a definite barrier between the nerve and surrounding muscle tissue; however, the micromechanical properties of the barrier and the resistance to tethering remain uncertain. Among the substances tested in both the 1987 and 1988 projects, ARGIN, in combination with GORE-TEX Vascular Graft, has been the most successful. It appears to have the most potential for imitating the body's natural areolar tissue, thus reducing scar tissue.

*Glenn T. Seaborg Nobel Prize Visit Award
First Award - Eastman Kodak Company
First Award - ISEF/Medicine and Health
First Award - U.S. Air Force
First Award - U.S. Navy
Honorable Mention - American Intellectual Property Law Association

DEVELOPMENT OF METHODOLOGY FOR DIFFERENTIATION OF SLOW LACTOSE FERMENTERS

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The organisms of the family Enterobactereaceae are divided into two large groups based on their lactose fermenting ability. The coliforms; including Escherichia, are capable of fermenting lactose. These are considered to be non-pathogenic. The second group are unable to utilize lactose and; except for Proteus, are pathogenic.

However, there are organisms referred to as slow lactose fermenters; including Citrobacter and Providencia. Because fermentation takes so long, they are often mistaken for non-lactose-fermenting pathogens. The development of a quick, effective, and inexpensive method for differentiating these species would be very beneficial. It is the aim of this research to substantiate procedures that will attain this goal.

Experimentation has concentrated in two areas. The development of precise pH indicator combinations has shown small but observable differences in the species. Fermentation studies with five alternate carbohydrate broths also provided worthwhile information. These results were evaluated on the basis of time required for positive identification. Results thus far have indicated the most effective carbohydrate-indicator combination to be maltose broth with the addition of .1% Phenol Red (1 part) - .1% Thymol Blue (3 parts). Verification trials have proven the indicator broth to be effective in all cases, though more testing is in progress at this time.

MIMOSA TENUIFLORA POIR: A NATURAL CURE FOR BURNS FROM THE MAYAS.

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5519 NATO 10-A, El Paso, Tx. 79924

The pulverized bark of *Mimosa tenuiflora poir* -Tepescohuite or Skin Tree-, an ancient cure for burns used by the Mayas, was compared in effectiveness to the traditional treatment with silver sulfadiazine cream used in the regional burn care center. A licensed veterinarian applied Xylocaine with Epinephrine as a local anesthetic, and then induced two burn wounds of a radius of 6 mm using a cauterizer. One of the wounds was treated with silver sulfadiazine cream and the other one with the pulverized bark. It must be clear that the traditional treatment was used as control because it was impossible, for humane reasons, to leave a wound untreated. All rats received treatment for both burns. The area healed by both treatments was measured every two days to compare the rate of healing of the two treatments. Observations on the progress each wound made were recorded every day, as well as the final appearance of the injured areas. Those wounds treated with *Mimosa tenuiflora* healed in approximately half the time the others did, leaving no scars. The rats were housed at the veterinary clinic during the entire time they were handled and treated, being under the constant care and supervision of the veterinarian, his staff and the student researcher during the entire time they were handled and treated.
I hope a proffesional medical researcher will look closely at the outcome of this experiment. *Mimosa tenuiflora poir* may be the needed cure sought for so long by medical science.

MICROBIOLOGY

MICROBIOLOGICAL DESCRIPTION OF HIGHLY HALOPHYLIC BACTERIA FROM SALT FLATS

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Salt flats are areas covered by shallow ponds through which sea water is run until most of its sodium chloride crystallize. These sea pools are rich in their population of bacteria, which in most cases is made evident by the pigmented appearance of the water. The purpose of this study is to isolate and identify the major bacterial components of the salt flats near El Faro, at Cabo Rojo, P.R. The ecological and physiological significance underlying the occurence of highly halophylic marine bacteria in the water and sorroundings of these flats is also under investigation.

Intense red and yellow growths have been isolated. In every case, flat, smooth, circular colonies, with entire to locate margins were identified. Collected results suggest a Gram positive, non-acid fast, agar digesting coccus, with consistent growth in the range of 0 to 30% salt content in the media and incubated under 36 degrees celsius, to be the cause of the characteristic pink coloration shown by the flats of this area. Pigment isolation techniques and specific metabolic assays are being developed in order to complete the identification of these balophiles, which live in an environmental of unmeasurable salinity and high ozone concentrations.

* EFFECT OF CYCLIC 3'5'ADENOSINE MONOPHOSPHATE ON DICTYOSTELIUM DISCOIDEUM

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PURPOSE: To ascertain if the gradient of cyclic 3'5' adenosine monophosphate (cAMP) determines polarity of the migratory pseudoplasmodia (grexes) of Dictyostelium discoideum.

PROCEDURE: Sephadex particles soaked in concentrations of cAMP ranging from $5x10^{-3}$M to 10^{-1}M were placed on the posterior end of grexes to reverse the gradient of cAMP. Photomicrographs were taken at various intervals to trace the movements of the grexes.

RESULTS: All 14 grexes implanted with $5x10^{-3}$M cAMP were indistinguishable from grexes implanted with Sephadex particles soaked in water. 8 of 9 grexes acted in an abnormal fashion with $1x10^{-2}$M, detailed in the paper. Of the 21 grexes implanted with $1x10^{-1}$M cAMP, 12 grexes divided into anterior and posterior portions, with the posterior portion remaining with the Sephadex particles.

CONCLUSION: Not only are grexes sensitive to cAMP during migration, but they also seem to use cAMP to direct their motion, and consequently, polarity. With high concentrations of cAMP, extreme losses of polarity resulted, including separation of the anterior from the posterior. This observation supports the hypothesis that the posterior cells were attracted to the high cAMP source and consequently that polarity within that portion was indeed reversed.

*Honorable Mention - Eastman Kodak Company

TRANSFER OF THE LACTOSE HYDROLYZING TRAIT BY CONJUGATION IN STREPTOCOCCUS LACTIS.

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The objective of this study was to see if in Streptococcus lactis the plasmid carrying the lactose-gene can be transferred from lactose-positive cells to lactose-negative cells by conjugation. To accomplish this objective, specific strains for donor and recipient were selected. The lactose-positive donor was very sensitive to streptomycin and carried the plasmid encoded lactose-gene. The lactose-negative recipient, lacking any plasmid, was partially sensitive to streptomycin. But, by growing the recipient cells on increasing concentrations of streptomycin up to 600 ug/ml, a streptomycin-resistant strain was developed. After allowing the donor and recipient cells to carry on conjugal mating, the transconjugants, which were lactose-positive and streptomycin-resistant, were isolated on a lactose-streptomycin agar medium plate. Plasmid profile analysis of the donor, recipient, and two transconjugants showed that the transconjugants did acquire one specific plasmid of about 40 Mdal from the donor. Because the transconjugants were lactose-positive, this specific plasmid, both in the donor and the transconjugants, most likely encodes for the lactose-gene. For additional confirmation, lactose-negative mutants have been isolated by growing the donor and transconjugants in the presence of a plasmid curing agent (acriflavin) and their plasmid profiles are being analyzed to show the association of the 40 Mdal plasmid with lactose-hydrolyzing trait.

BACTERICIDE COMPARISON ON B. SUBTILIS AND P. AERUGINOSA

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This experiment compares the different disinfectants on a gram-positive bacteria, B. subtilis, and a gram-negative bacteria, P. aeruginosa. Each disinfectant was diluted into a common household solution. Sterilized stainless steel straight pins were introduced into each bacteria and then into each disinfectant. A pin was removed at 1, 5, 10, and 30 minute intervals and placed into nutrient broth. All samples were incubated for 48 hours. Bacteria growth was then measured with a spectrometer. Each disinfectant reacted uniquely on the two bacteria; however, since all of the disinfectants eliminated the two strains in a relatively short period of time, it was concluded that they could be equally effective if applied in the correct concentration and for the necessary duration.

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*SALMONELLA FOOD INFECTIONS IN CHICKENS

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The purpose of this project was to discover if the chickens sold in the grocery stores directly to the consumer posed a greater risk that previously presumed. The packaged fluid was collected from supermarket chickens taken directly from the retail meat display. The fluid was innoculated on SS Agar, MacKonckey Agar, EMB, Triple Sugar Agar, Lysine-Iron Agar and tests from gram positive or negative were done along with Indole and Urea Agar to determine if Salmonella was present. Plate counts were also done to determine the approximate numbers, but were inconclusive and the numbers varied and were quite high. The conclusion must be that the food infection, Salmonella, was present in most packages, but more work must be done to get better estimates of numbers and exact species of the Salmonella.

*Fourth Award - ISEF/Microbiology

"Can the Pseudomona Aerugenosa inhibit the growth of some fungies?"

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It's a truth that we live surrounded by thousands of microrganisms like bacterias, viruses and fungies. More amazing is to know that even though we share our environment with thousands of microrganisms, we don't fall into more infeccions caused by them. Of course, that the human body has some defense mechanisms both in an inmunologic level and in a physical level as well. Between this physical impediments, to more diseases, is our skin that when is healthy and clean helps to prevent infeccions by penetration into the skin. There are many times when this organism penetrate into the skin causing skin diseases. The interesting thing about this is that precisely some of the antibiotics that we use to treat this infeccions are substances produced by bacterias and fungies. To mention some of them: Penilicin which extract from Penicillium Fungie.

This proyect studies the possibility that a variety of Pseudomona Aerugenosa has the property of inhibit the growth of some fungies. It is believed that maybe a medicine or an antibiotic can be developed with this bacteria to fight some fungi that cause skin diseases.

THE EFFECTS OF SECONDARY TREATED EFFLUENT ON MICROBIAL SUCCESSION

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This research project aims at determining the effects of secondary treated effluent on microbial succession and is the second phase of a three year study of the wastewater. The city of Lakeland disposes of its wastewater in an area of reclaimed phospate land south of the city owned by W.R. Grace Co. Through underground pipes the water is diverted to an outflow station which disperses the water into a series of slow-flow filter cells. These cells are supposed to remove the harmful pollutants contained in the water, making it safe for later uses. This study aims at determing the effects that this wastewater and its pollutants have on microbial succession in this area.

The first portion of the research dealt with the water quality, which was tested using LaMotte and Hach methodology. Each of the following parameters were found in above average quantities in the wastewater: PO_4, SO_4, NO_3, CO_2, and acidity.

The second phase of the research was the experimental portion of the project and concerned the use of Winogradsky columns for the measurement of bacterial growth. Five colums were set up: Column 1 and Column 3 were controls for Column 2 and 4 respectively. Column 5 was strictly observational. Two basic types of bacteria were concentrated on: sulfate reducing and purple sulfer. Column 2 contained high amounts of each bacteria as did Column 4, and each column exceeded the amounts of bacteria contained by their respective controls.

Realizing that each of these two bacteria depend upon sulfur or sulfur compounds for their livelihood, it was concluded that their excessive growth was triggered by the high amounts of pollutants, particularly sulfur, that were present in the wastewater.

HOW DOES RADIATION AFFECT FRESHWATER MICROORGANISMS?

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IN MY PROJECT, I WANTED TO SEE HOW PARAMECIA WOULD BE AFFECTED IF I RADIATED THEM WITH DENTAL X-RAYS. I USED DENTAL X-RAYS SO I COULD COMPARE THE EFFECTS TO HUMANS.

IN THE OVERALL PROJECT, I MADE TWO EXPERIMENTS. IN THE FIRST ONE, I PHOTOGRAPHED SLIDES OF ALL THREE LEVELS OF RADIATED PARAMECIA BEFORE AND AFTER RADIATION WAS INTRODUCED. I DISCOVERED THAT MANY OF THE ANIMALS DIED OR WERE MUTATED GREATLY.
THE SECOND EXPERIMENT CONSISTED OF OBSERVATIONS OF THE MAJOR FUNCTIONS OF THE ANIMAL FOR A 40 MONTH PERIOD AND COMPARING THE RESULTS TO THE OBSERVATIONS OF A CONTROL CULTURE. I WOULD ISOLATE 100 ANIMALS A MONTH FOR EACH PROCESS BEING STUDIED.

I CONCLUDE FROM MY FINDINGS THAT RADIATION GREATLY AFFECTS FRESHWATER MICROORGANISMS AND COULD TOTALLY WIPE OUT THE BASE OF THE AQUATIC FOOD CHAIN. I ALSO CONCLUDE THAT A NUCLEAR ACCIDENT OR WAR COULD DESTROY THE MICROORGANISMS AS SEEN BY THE RESULTS OF THE CHERNOBYL ACCIDENT.

BIOCHEMICAL AND MUTAGENIC ACTION OF SIX BACTERIA FAMILIES AND THE YEAST *Candida albicans* IN RELATION TO AMINOACID SYNTHESIS

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Magnesium is an element of nature which is uses by plants to form the molecules of chlorophyll. In the same manner the human body uses it in the formation of bone tissue but in small amounts. In our bone system there is about 35 to 40 miligrams of magnesium. When test were made on experimental rats (*Mus musculus*) an excessive amount of cation Mg^{+2} was administered for 90 days an it was proved that an abnormal growth of lung cell tissue was the result. This characteristic is attributed to the filtration of the blood capillaries which accumulate part of the cation studied. Given this pre- study results a base for my purpose of knowing the mutagenic activities upon the cells I decided to apply cation Mg^{+2} to different bacteria of six different families and over yeast (*Candida albicans*). Onces the sensitivity test were carried out I noticed that 40% of them were not resistant to the cation for that reason they did not show growth. Sixty percent of them presented growth but with zones of inhibition Changes in the form of colonies, edges and bacteria pigmentation were observed. I then proceeded to add Mg^{+2} to the culture media so as to carry on inoculations to 60% of the bacteria that presented growth, and the colonial changes mentioned. When I realized the Gram Stain these were noticeable in 20% of the bacteria making Mg^{+2} plus the components of the celular walls responsible for those changes. Finally trough the microscopic observations I became aware that 20% of the bacteria (*E. coli* *S aureus*) and *Candida albicans* presented celular elongations and changes in the sequence of amino acids but the most noticiable were those of *S. aureus*. information that confirms the hypothesis

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MAXIMIZATION OF FUNGAL ANTIBIOTIC PRODUCTION

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Antibiotics are substances produced by various microorganisms, including bacteria and fungi, that inhibit the growth of or kill other microorganisms. Their importance is clearly evident in medicine as drugs that fight disease-causing microorganisms. Most antibiotic-producing organisms, however, will not produce enough antibiotic material to be practical for large-scale production, when standard culture media and techniques are used.

The purpose of this project was to isolate potential antibiotic-producing fungi from the soil and to determine the culture conditions that would enhance antibiotic production. It was hypothesized that the factors of carbon and nitrogen sources in the culture medium, temperature, and surface-to-volume ratio would affect the antibiotic production in fungi. Fungi were isolated from five different soils, using the dilution-plate method. Each isolate was tested for antibiotic activity against gram-positive and gram-negative bacteria and those found to exhibit activity were tested under various culture conditions. It was found that increased surface-to-volume ratios, varying temperatures, the carbon sources sucrose and malt extract, and the nitrogen sources sodium and ammonium nitrate all affected antibiotic production by increasing the quantity of the antibiotic produced.

* STRUCTURAL VARIATIONS OF DYNEIN ARMS IN TETRAHYMENA CILIA IN THE PRESENCE OF ADP AND VANADATE

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Demembranated cilia from Tetrahymena thermophila were treated with adenosine diphosphate and vanadate (an ATPase inhibitor) in order to lock the dynein arm (the ciliary ATPase) into the flattened form (a shortened form) of the mechanochemical cycle.

Electron microscope examination revealed two populations of dynein arm lengths. The flattened form, with a mean length of 13.55nm and an elongated form, whose mean length is 21.92nm.

Each of the doublet microtubules contained only one of the populations of arm lengths, rather than having two arm lengths intermixed on the same doublet. This is an indication that the doublets with the flattened arms were in an active state, and the doublets with the elongated arms were in an inactive state. This conclusion supports the Switch-Point Hypothesis, which states that doublets are either active or inactive at a given time. This theory explains how a cilium undergoes an effective and a recovery stroke.

*London International Youth Science Fortnight Trip - U.S. Navy
First Award - ISEF/Microbiology
Honorable Mention - American Society for Microbiology

EXPLORING THE USE OF ULTRAVIOLET LIGHT AS A BETTER BACTERICIDE FOR MILK AND ITS SPECIFIC EFFECTS ON REDUCING LACTOBACILLUS SPECIES AND THE POSSIBLE IMPACT ON REDUCING ALLERGIC REACTIONS TO MILK IN A NATIVE AMERICAN POPULATION

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Initially, ultraviolet light was used on raw and pasteurized milk samples to determine its lethal effect on the bacteria species that cause milk spoilage. These samples were then plated on Eosin Methylene Blue, Standard Methods agar, MacConkey media, Violet Red Bile, Litmus milk broth and Peptone broth. Little difference appeared in bateria count and types, on these specific agars and broths. The three most common bacteria found in the samples were Escherichia coli, Hemopholis sp., and the Lactobacillus sp. The Hemopholis sp, and the Lactobacilli were by far the most abundant over the E. coli.

Suprisingly however, the ultraviolet light seemed to increase bacterial growth except in the Lactobacillus species in which the number was notably reduced. For this reason a correlation was run between Lactobacillus count and the amount of lactose produced in the milk, working on the premise that the Lactobacilli would reduce spoilage but also allow the other bacteria species to possibly reduce the lactose level in milk thus making it more palatable to lactose intolerant individuals, as the genetic frequency of this characteristic is extremely high on the Blackfeet Indian Reservation, Glacier County, Montana.

Present research is involved with determining lactose levels of raw and pasteurized samples before and after they are exposed to the ultraviolet light.

* MAPPING AND CLONING OF THE hem B GENE IN E. coli.

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This study was designed to determine the genetic basis of the gentamycin resistant variant (small colony) strains in E. coli. These strains exhibit multiple phenotypic differences from the parental strain in that they are anaerobic, show low level resistance to all aminoglycoside antibiotics, and have a biochemical diagnostic profile which would not identify them as E. coli (V-) although they carry all genetic markers of the parent strain (V+). Using conjugational and transductional mapping techniques attempts were made to determine the existence and position of the putative V- gene. Variants were induced in both F- and Hfr strains. Conjugational mapping identified a V- gene in the vicinity of lac. Transductional mapping has identified 3 possible mutations in the hem B, hem A, and hem C genes, each of which induce a slow growing phenotype. I have also been able to clone the wild type hem B gene into the plasmid pUC19. However I have not yet been able to isolate the gene from the plasmid because the hem B gene may have the same molecular weight as the plasmid.

*First Award - U.S. Navy
Second Award - American Society for Microbiology
Second Award - ISEF/Microbiology

LASER VS PLANT CANCER

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This project was a study to see whether a laser beam has an effect on the growth of crown gall in the tomato plant. First, sixty tomato plants were grown to maturity of 8-10 inches. Then, fourteen plants were inoculated with Agrobacterium tumefacians (A.T.) and lasered for various amounts of time. Two were inoculated with A.T. lasered for one minute, two for two minutes, two for four minutes, two for eight minutes, two for sixteen minutes, two for thirty two minutes and two for sixty four minutes. Another fourteen plants were inoculated with A.T., then immediately lasered at the site of the inoculation for the same amounts of time as before. Six plants were just wounded. Finally, six more plants were wounded, then inoculated with A.T. and not subjected to any laser at all. The plants were then rated on a scale of 0-10, once a week for six weeks, to determine growth of galls. In conclusion, it was found that lasering the A.T. was effective as a method of slowing down the growth of crown gall in the tomato. As the bacteria's time of exposure to the laser increased, the size of the gall decreased. It is hoped that in further studies, that the bacteria will be able to be lasered to a point where, upon inoculation in the plant, it will not infect the plant, but the plant will build up an immunity to the bacteria, therefore protecting the plant from the disease plant cancer.

IS CEPACOL REALLY BETTER THAN LISTERINE?

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In my project I tried to determine if Cepacol is a better mouthwash than Listerine by running five tests with S. aureus bacteria.

1. Filter Paper Disk Diffusion Technique: Cepacol made average zones of inhibition of 15.23mm; Listerine made average incomplete zones of inhibition of only 14.39mm.
2. Turbidimetry Determinations of Mouthwash-treated Bacterial Suspensions with a Photocolorimeter: Light transmittance readings for Cepacol cultures dropped 10 points and 8 points in 3 minute runs. Light readings for Listerine cultures dropped only 5 and 5.5 points. Since the time involved did not allow for bacterial reproduction big enough to decrease transmittance this much, the decrease must have been caused by the breakdown of dead bacteria. Cepacol seems to have made a larger kill.
3. Phenol Coefficient Tests: According to the literature, the mouthwash with the higher coefficient is better. The coefficient for Cepacol was 0.0833 and for Listerine 0.0125.
4. Examination of S. aureus with a Scanning Electron Microscope: S. aureus treated with Cepacol appears to show more breakdown than S. aureus treated with Listerine.
5. Light Microscope Examination of Bacterial Cultures Treated with Mouthwashes: Bacterial counts of slides of S. aureus treated with Cepacol totaled 274. Bacterial counts with Listerine totaled 576. Cepacol reduced bacterial numbers better than Listerine.

These five tests show that Cepacol is a better mouthwash than Listerine.

MORPHOLOGICAL AND BIOCHEMICAL EFFECTS OF AQUEOUS EXTRACTS OF TOBACCO SMOKE ON GROWING CELLS

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The purpose of this project was to study the morphological and biochemical effects of aqueous extract of tobacco smoke in growth media on growing cells in vitro. Baby hamster kidney cells (BHK-21) were cultivated and used for this investigation. A previous study showed that the effect of tobacco smoke extract on cell growth in vitro was concentration dependent. High concentration of smoke extract in media inhibited, while low concentration stimulated, cell growth. It was also shown that second-hand smoke from a burning cigarette was 25% as toxic to growing cells as the primary smoke. It was observed that cells exposed to cigarette smoke treated media exhibited morphological changes. The cell membrane appeared to be rough and jagged. Incubated in the presence of influenza viruses, smoke treated cells were found to be more susceptible to viral infection as illustrated by the hemadsorption experiments. Meanwhile, results revealed that the cell membrane of uninfected cells exposed to cigarette smoke extract became sticky as chicken blood cells adhered to them. Biochemical studies in this project demostrated differences in cells grown in normal and cigarette smoke treated media. A time study of the decrease in pH in the growth media showed a more gradual change when cells were cultivated in a media containing a growth inhibitting concentration of smoke extract than in normal media. Studies on one enzyme, adenosine deaminase, showed a decrease in enzyme concentration in treated cells; other analytical studies of this enzyme were also attempted.

CARICA PAPAYA L. AN ANALYSIS OF POSSIBLE ALLELOPATHIC PROPERTIES ON DIFFERENT SEEDS AND MICROBIOLOGCIAL ASSAYS

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The carica is a tree from South America. Its ripen fruit is greatly eatable, freshly or preserved and its pulp or fresh is made as a beverage. The inmature fruit is also used as a vegetable. It has been observed that in many places where this tree is cultivated other plants do not grow. According to River (1948) release of the phytotoxic metabolitic by crop plants (allelopathy) is a possible mechanism of weeds.

To determine the possible presence of allelopathic agents, extractions were prepared using different parts of the tree at concentrations of 5%, 25%, 50% and 75%. These concentrations were applied to different seeds finding that the green (inmature) seed inhibited 80% of the growth of *Phaseolus vulgaris Cajan cajan* and *Cajanus cajan* when used in concentrations of 50% and 75%.

Microbiological assays were made with five bacterias grampositive and three gram-negative. The following extractions presented positive results in ripen seed extractions with ethyl acetate seven bacterias were inhited *Staphylococcus aureus* (47mm) and *Escherichia coli* (31mm), in methanolic extractions four bacterias were inhibited and in pure sarcotesta extraction four bacterias were inhibited.

Chemical analysis are in progress to determine if the substance that causes allelopathic effects is the same that inhibits the growth of bacteria.

A COMPARISON OF TYPES AND AMOUNTS OF BACTERIA AT THREE LEVELS FROM ACID MINE SPOIL AND UNDISTURBED SOIL

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Because soil from strip mine spoil is altered due to loss of organic nutrients, distuption of biological processes and addition of acid mine effluents, it can be assumed that microbial populations will be significantly affected and permanently altered. The number of bacteria may increase with soil depth in normal soil but may be different in soil from strip mines. This project was undertaken to find out the types and amounts of bacteria found in normal soil and acid mine spoil at four different levels.

Soil samples were taken from Cedar Creek, Texas and strip mine soil near Columbus, Texas. These soils were originally similar in composition. Bacteria were isolated from 3, 6, 9, and 12 inches. Bacteria were identified using standard methods. Plate counts were done to determine populations. Results showed a decrease in bacterial types and number for the acid mine spoil sample. Sixty isolates were obtained from acid mine spoil compared to 83 from normal soil. Numbers and types of bacteria at each level were also significantly different. Results also show a varied bacterial population in the A horizon of the normal soil. *Bacillus* sp. predominated the profile in the normal soil. *Micrococcus* sp. were found in the upper three inches of soil as were most of the other aerobic isolates. Most soil bacteria from both sites were non-fermentative gram negative facultative rods. Differences in acidity (3.8pH-acid mine spoil, 6.8 undisturbed soil) is the most important factor in the differences in types and numbers of bacteria from the two sites. It is apparent that strip mine spoil, even after a period of ten years is significantly and perhaps permanently altered when compared to undisturbed soil of similar type.

*A THREE-YEAR STUDY OF PRODIGIOSIN SYNTHESIS IN Serratia marcescens: PHASE III - CLONING SPECIFIC PIGMENT GENES

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Prodigiosin is an organic pigment produced by several strains of Serratia marcescens. The pigment, synthesized by a bifurcated (split) pathway, makes the organism ideal for genetic research. The purpose of Phase III was to clone the genes from the larger branch into an E. coli plasmid, then obtain transformants of Serratia marcescens (WF) which carried the new plasmid. Because the mutant (WF) is blocked in the larger branch of the pathway, transformants expressing red pigmentation would be carrying the specific genes necessary to repair that branch.

E. coli plasmid pBR325 was isolated and grown in wild-type S. marcescens (NIM) in order to avoid later problems encountered when crossing restriction groups. Gel electrophoresis confirmed the success of the transformation. Preparations were made of pBR325 and wild-type Serratia chromosomal DNA. Cuts were made using restriction enzyme Bam H1, and DNA fragments were incubated in the presence of ligase. The recombined DNA was introduced into S. marcescens (WF), and the cells were plated selectively for chloramphenicol resistance (carried on pBR325). This final transformation will be repeated until red pigmentation is expressed in the mutant strain.

The M.I.C. of chloramphenicol was found to be 25 ug/ml. This concentration was used in all antibiotic-supplemented media. Six transformants of (NIM) were isolated that carried pBR325, and one was used for the purification of the plasmid to be used in cloning. Gel electrophoresis confirmed the cleanness of both the plasmid and chromosome preparations. An ethidium bromide assay of this DNA estimated the concentrations to be 1 mg/mL for the chromosome and 4 mg/mL for the plasmid. The final cloning step has not produced any transformants of (WF); however, DNA is prepared for this purpose.

***Fourth Award - ISEF/Microbiology**

EVOLUTION IN BACTERIA: THE EFFECTS OF TWO ANTIBIOTICS ON E. coli

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This experiment was designed to show the development of antibiotic resistance in E. coli. Two commercial brands of Oxytetracycline were used -- Oxy Tet 100 and Terramycin 100.

E. coli were cultured onto three MacKonkey agar plates. Distilled water was used as a control; the remaining two were treated with a solution of distilled water and one of the antibiotics. Plates were incubated at 37° C for 24 hours. Resistant colonies were recultured and treated with a higher concentration of antibiotic. This process was repeated twice in phase I and four times in phase II. Phase I antibiotic concentrations were 25% and 50%. Phase II concentrations were 12.5%, 25%, 37.5%, 50%, and 62.5%. Colonies resistant to the highest concentration and colonies from the control plate were recultured and treated with the original concentration of antibiotic indicating a development of antibiotic resistance. In phase I the number of colonies resistant to antibiotic A ranged from 0 to 16. The number of colonies resistant to antibiotic B ranged from 35 to 132. In phase II colonies resistant to antibiotic A ranged from 15 to 184. Colonies resistant to antibiotic B ranged from 33 to 162. Colonies on all control plates were too numerous to count.

Results of these tests indicate that application of increasing concentrations of Oxytetracycline to successive generations of E. coli will cause it to develop resistance to this antibiotic.

* NOT FIT FOR HUMAN CONSUMPTION PHASE IV PLASMID ISOLATION

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The herbicide 2,4-Dichlorophenoxyacetic acid (2,4-D) is used to control broadleaf weeds in both crop and noncrop lands. In concentrations of 1.5 mg/L, 2,4-D has been shown to be lethal to blue-green algae and in higher concentrations, lethal to nitrogen fixing bacteria thereby reducing nitrogen fixation. It has also been shown to be lethal to *Daphnia*, an aquatic microinvertabrate. Recent studies into the microbial degradation of compounds such as 2,4-D and the genes involved in its metabolic degradative pathways have shown that genetic manipulation *in vitro* can enhance the biodegradative potential of new strains over their naturally existing counterparts.

Phases I and II of this project examined the toxicity and mutagenicity of several chemicals using microorganisms as test systems. Among the compounds tested which exhibited a toxic response was 2,4-D.

Phase III involved both classifying a bacterium, (22 DCP) shown to degrade 2,4-D, and determining that gene trait for 2,4-D degradation was located on the plasmid. The bacterium was identified as a *Pseudomonas*. The Kado and Liu plasmid isolation technique was used to determine the presence of a plasmid in 22 DCP. This procedure resulted in the isolation of one plasmid approximately 124 mDal in size.

Phase IV utilized a technique described by Hirsch, *et. al.* to obtain the quantity of plasmid DNA from 22 DCP necessary for a restriction map.

A practical application for this work would require splicing the genes responsible for 2,4-D degradation into a plasmid and inserting the recombinant plasmid into a microorganism capable of successfully competing in the environment. This type of research could produce an organism with an increased efficiency to degrade 2,4-D, a viable tool to reduce 2,4-D contamination in the environment.

*First Award - U.S. Air Force
Fourth Award - ISEF/Microbiology

DO MARINADES RETARD MICROBIAL GROWTH?

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Chicken is a popular entree due to its low cholesterol level, yet chicken improperly cooked is quite dangerous because of its high level of microbial growth.

In a previous experiment, I determined that oven-roasting proved to be the least effective cooking method for chicken when comparing the following methods: oven-roasting, microwaving, boiling, grilling, or frying.

Since oven-roasting chicken is a method preferred in my home, I decided to determine if marinades would be effective in decreasing the growth of microbes.

Through my investigation, I analyzed the microbial growth of chicken marinaded in the following sauces: lemon, wine, oil & vinegar, and the commercially prepared teriyaki marinade.

Slides were prepared from the chicken samples to compare the effects of various marinades and differing cooking times on the types and amounts of microbes produced. Also, an acidity test was performed which found that the acidity has a definite effect on the bacterial growth.

THE EFFECTS OF ULTRAVIOLET RADIATION ON MICROORANISMS

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The purpose of this project was to determine the effects of ultraviolet radiation on four bacteria species, *Escherichia coli*, *Bacillus subtilis*, *Pseudomonas fluorescens*, and *Serratia marcescens*. The researcher hypothesized that the bacterias' reproduction capabilities would be impaired by the ultraviolet radiation.

Each specimen was cultured in nine petri dishes with the exception of *E. coli* which was cultured in eighteen. The groups were exposed to ultraviolet radiation for 0 sec., 15 sec., 30 sec., 45 sec., 60 sec., 75 sec., 90 sec., 105 sec., and 120 sec. The groups were then incubated in the dark (excluding set B of *E.coli*) at 31°C. Set B of *E.coli* was incubated in the light to test the repair capabilities of photoreactive enzymes.

As a result, *B. subtilis* was the first to die, then *S. marcescens*, *P. fluorescens*, *E. coli* set A (dark), and then *E. coli* set B (light). None of the bacteria survived after the 120 sec. mark. The radiation terminated the bacterial growth because it caused adjacent thymine bases in the DNA to undergo a reaction which resulted in the formation of thymine-dimers. Thymine-dimers block the base pairings required for the replication of DNA daughter strands.

Ultraviolet radiation may be used to minimize the growth of bacterial populations in hospital operating rooms. Radiation could also be used to destroy internal bacterial infections by exposing the infected site to radiation during surgery performed specifically for that purpose. In contemplating such a procedure, however, the possible risk of such side effects as skin cancer and other cell damage must be carefully considered.

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* THE EFFECTS OF pH CHANGES ON DAPHNIA, OSTRACODS, AND COPEPODS

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The problems to be tested are: 1. How are Daphnia, Copepods, and Ostracods affects by pH changes? 2. How is reproduction in Daphnia Affected by pH changes? 3. How are Daphnia under altered light amounts affectd by pH changes? 4. How are Daphnia under altered temperatures affected by pH changes? Take three sets of nine jars containing 100 ml of spring water and alter the pH from 4.0 to 8.0 in half step increments using super saturated baking soda solution and 10% sulfuric acid. Measure the pH with pH paper. Add one Daphnia, Copepod, and Ostracod to each jar in their respective set. Observe for five days. Record the Daphnia's heart rate every ten minutes for the first three hours. Using one set of these jars, place one, day-old Daphnia in each jar. Record the number of your produced for fourteen days. Using three sets of jars with pH from 3.0 to 9.0 in full step increments, odd one, day-old Daphnia to each jar. Each day place groups one, two, and three under zero, twelve, and 24 hours of light, respectively. Observe for five days. Repeat this procedure placing the jars in 15, 20, and 25 degree Celsius rooms. The Daphnia and Ostracods died at pH 4.0 and the Copepods died at pH 4.5. The Daphnia's heart rate increased and reproduction decreased when the pH was altered. Total light caused Daphnia to die in pH 8.0 and pH 9.0. Colder temperatures caused death in pH 5.0. Warm temperatures allowed them to live in pH 4.0.

***Fourth Award - ISEF/Microbiology**

EFFECTS OF X-RAYS AND UV LIGHT ON PLASMIDS OF ESCHERICHIA COLI, PSEUDOMONAS AERUGINOSA, STAPHYLOCOCCUS AUREUS, PROTEUS VULGARIS AND STREPTOCOCCUS AGALACTEAE AND THEIR RESISTANCE TO ANTIBIOTICS

Wanda Morales-Hernández, Lino Padrón Rivera
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Antibiotics are still one of the most effective ways to save lives and fight diseases. Could it be possible that plasmids that confer resistance to antibiotics to Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, Proteus vulgaris and Streptococcus agalacteae are affected by X-rays and UV light and thus produce more or less resistance? If the application of X-rays and UV light produces any changes in the resistance of these bacteria to antibiotics, it could be due to change in bacterial plasmids. The objectives of this research were: 1. To determine the presence of plasmids in these bacteria. 2. To determine if the plasmids of these bacteria are affected after being exposed to X-rays. 3. To study the effect of X-rays and UV light on plasmid DNA by observing any changes in bacterial resistance to certain antibiotics. To measure the resistance of bacteria to antibiotics, sensitivity tests were performed using five different bacterial genera. Escherichia coli K-12 which contains th plasmid pBR322 (coding for ampicillin resistance) was used as a control. Plasmids were extracted and purified. Bacteria were exposed to X-rays and UV light. Bacteria were then replica-plated onto plates containing ampicillin to verify if E coli still contained its plasmid. Preliminary results show the presence of plasmids in the five bacterial species. X-rays have no effect on the plasmid of E coli K-12. UV light has a strong bactericidal effect, but its effect on plasmids is currently being investigated.

AUGMENTATION OF IL-2R BY THYMOSIN

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Thymosin, a series of peptides secreted by the thymic epithelial cells, promotes the maintenance and control of cellular immunity. The maturation of T cells through the stimulation of thymosin plays a key role in lymphokine production, as shown in this investigation by the augmentation of interleukin 2 receptors (IL-2R). Interleukin 2 (IL-2), a lymphokine produced by activated T cells, supports the growth and differentiation of thymus-derived cells. The interleukin 2 receptor is an antigen expressed on the T cell surface, which specifically binds IL-2. The appearance of IL-2R is critical for the generation of lymphocyte proliferation. Since thymosin enhances lymphoproliferative responses, this study examines the effect of thymosin on the expression of IL-2R. Mice were treated in vivo with thymosin fraction 5. Cell suspensions were made from the spleens and cells were cultured in a MLR, in which in vitro administration of thymosin was added as another experimental factor. After three days, cell suspensions were fluorescein conjugated and analyzed by flow cytometery. Thymosin did increase interleukin 2 receptor expression by 25% in vitro. In addition, it is shown that only cells that are expressing IL-2R are also replicating DNA. Thymosin also increased the number of active T cells. From the results of this experiment, the application of thymosin could be applied in many various clinical situations including AIDS, and radiation exposure. A very prominent and immediate application of thymosin's ability to increase IL-2R expression, can be linked to the LAK therapy developed by Dr. Steven Rosenberg to kill cancer cells.

Using Mutagens to Transform and Select S. aureus to a Gamma-Hemolytic State

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The purpose of this research is to induce transformation and selection of a beta-hemolytic S. aureus to a gamma-hemolytic state using acridine orange and long-wave UV radiation. It was hypothesized that the mutagenic factors would create the desired changes in the S. aureus.

A clonal cell line was created using beta-hemolytic S. aureus grown on a blood agar plate in an aerobic environment. A suspension of the beta-hemolytic cells was then created in trypticase soy broth.

The acridine orange was then introduced to the suspension in a dilution of 1:760. At the same time, 1260 Joules of UV radiation was introduced to a second portion of the S. aureus. These groups were then incubated and examined for positive hemolysis/lack of hemolysis.

The transformed plates were then artificially selected. Using control bacteria and the replicate plating method, the bacteria were grown with the clonal cell line bacteria, and the results were recorded.

The experiment was repeated three times, using three dilutions of acridine orange (1:760, 1:800, 1:830), and three measurements of UV radiation (1260 J, 990 J, 730 J). Results from the three experiments were compiled and the conclusion was drawn.

In all three experiments, with an increasing amount of acridine orange, the cells responded favorably, both in transformation and selection, but with the UV, massive cell death occurred, stopping most of the transformation and selection.

It was concluded that the introduction of mutagens to S. aureus will work using acridine orange and that this would be beneficial to medicine if hemolysis could be stopped using this method of transformation and selection.

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*GAMMA RADIATION INDUCED DAMAGE TO BACTERIAL PLASMIDS

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How does gamma radiation affect the pBR322 plasmid of E. coli? This experiment uses an R plasmid to simulate the effects of radiation on plasmids responsible for pathogenicity. Botulism, tetanus, and scarlet fever are plasmid-encoded diseases. If plasmid mutation can occur, instead of high-dose irradiation to kill, a lower dose could be used to mutate bacteria from pathogenic to non-pathogenic form. If bacteria are exposed to gamma radiation, plasmid damage may occur because radiation causes the formation of free radicals. Various mutations may occur.

E. coli with pBR322 plasmid was grown and optical densities were taken. Experimental groups were irradiated (Cs-137); controls were not. Cells were resuspended in antibiotic and non-antibiotic media for screening. After incubation, optical densities were taken and colony counts were done. The indicator for mutation to antibiotic sensitivity was less bacteria in antibiotic media than in non-antibiotic media.

Mutations on plasmid pBR322 were shown by changes from antibiotic resistant to sensitive. The hypothesis was true. 6% and 5% mutation occurred at 50 and 100 Krad. Also, as the dose of radiation increased, the percent of survival of E. coli decreased. Results from this research show that gamma radiation can mutate plasmids, and it is theoretically possible for a bacterium to be mutated from pathogenic to non-pathogenic. However, the frequency of mutation would have to be increased for practical application.

*First Award - ISEF/Microbiology

DIRTY MONEY: A STUDY OF BACTERIA ON U.S. COINS

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The purpose of my study was to investigate the presence of bacteria on U.S.coins and how long they are able to survive on the metalic surfaces of the coins.

My hypothesis is that if bacteria are present on the coins they will not survive for a long period of time.

The method used in this study was to innoculate nutrient agar plates with the bacteria from the coins which included cents, nickels, dimes and quarters. This was done either by direct contact or by using a sterile cotton swab to carry out the transfer.

A variety of bacteria were observed on all of the coins. However, coins that were not in circulation recently did not have as much bactteria on them as other coins which were just handled. To help to provide a control some coins were dipped into a mixture of bacteria to insure that the bacteria were evenly distributed over the coin. The bacteria from these were then used to innoculate the nutrient agar plates at various time intervals after the coins were dipped.

I found that the bacteria on coins survive for varying amount of times depending on the initial dosage of bacteria on the coins either by handling or dipping. The results of my study can be used to control the spread of infectious diseased caused by the handling of coins. It could be especially helpful to cashiers, people who play slot machines and others who handle a large amount of coins.

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*THE MECHANISM OF RETINOIC ACID INDUCED EFFECT ON CELL GROWTH AND DIFFERENTIATION

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Retinoic acid (RA) is a well known agent which can affect cell growth and differentiation. The mechanism is unclear. A simian virus 40 transformed fetal rat hepatocyte exhibits less sensitivity to RA than the non-transformed hepatocyte. RA induced 70% inhibition of plasma membrane electron transport of non-transformed (NT) cells but showed no inhibition on transformed (T) cells. Growth stimulation on NT cells by serum also showed a stronger sensitivity to RA inhibition than observed on T cells. A great deal of reduction in the NAD level was found in NT cells but not in T cells after the treatment of RA. RA also induced giant cell formation with NT cells but had no effect on the morphological change of T cells at 10^{-5}M. Specificity was shown by RA but not by retinol or retinyl acetate. I therefore, postulated that the mechanism by which RA acted began at the plasma membrane. It induced an inhibition of transmembrane electron transport activity, causing a reduction of NAD which resulted in a down regulation of inosine monophosphate dehydrogenase, a crucial enzyme in nucleotide biosynthesis, and a decrease in GTP which might bind to a cytoplasmic inducer that was in an uninduced state. It was thought that the fall in GTP resulted in the dissociation of GTP from the inducer and allowed the derepressed inducer to activate specific genes and induced differentiation

*Second Award - Tissue Culture Association

EFFECTS OF ANTIBIOTICS ON INTESTINAL BACTERIA RESISTANCE IN PIGS

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Bacterial resistance to antibiotics is one of the main drawbacks of antibiotic therapy, and almost every species of bacteria has members that carry the genes for resistance. Resistance implies that a drug is no longer effective in suppressing the growth and multiplication of microorganisms. Practices being blamed for the rapid spread of antibiotic resistance include the inappropriate administration of antibiotics to human patients, hospital's procedures when using antibiotics, and the use of antibiotics in animal feed to help prevent disease and promote weight gain.

In this study, fecal residue was collected from two feeder pigs which were being fed low levels of chlortetracycline. Several types of bacteria were isolated and tested for resistance to tetracycline. The bacteria which showed the greatest resistance were then tested for resistance to seven other antibiotics; chloramphenicol, erythromycin, kanamycin, neomycin, novobiocin, penicillin G, and streptomycin. A control disc was used on one plate.

All of the bacteria which were isolated showed resistance to tetracycline. The bacteria which had shown the greatest resistance was also resistant to all of the antibiotics tested, with the exceptions of chloramphenicol, kanamycin, and neomycin. Because of the low concentration of antibiotics in these tests, the results could be different with higher doses of antibiotics.

If resistant bacteria can indeed be passed from animals to humans, bacteria such as these might be very difficult to treat because of their resistance to a wide variety of antibiotics.

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*THE PHOTOBIOLOGICAL PRODUCTION OF HYDROGEN BY CYANOBACTERIA

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Due to the dwindling supply of fossil fuels, the U.S. must find newer and more efficient sources of energy. Hydrogen is an excellent source of energy, but it is produced by chemical processes which have harmful by-products. This project is designed to test the Hydrogen producing abilities of mutant cyanobacteria through a process called biophotolysis.

The organism used in the experiment is a laboratory strain of cyanobacteria named mutant Anabaena Variabilis, or SA-1. Theoretically SA-1 can produce H_2 in the absence of Nitrogen. It is a N_2-fixing bacteria, and this process requires almost the entire energy supply of the cell. With no N_2, it is impossible for the cells to undergo N_2-fixation and therefore, the cells should have enough energy to synthesize H_2 through the Nitrogenase enzyme system. The actual experiment involves the innoculation of airtight bottles with a set amount of cells and varying amounts of fructose and ammonium. The bottles are degassed and placed under illumination for twenty-four hours. The readings are converted into nanomoles of H_2 by using a conversion factor.

In further experiments, I plan to try using different variables on the cells and to use larger cultures. Perhaps in the future, Hydrogen produced by this method could be used by NASA to power rockets or to fuel other vehicles. Hydrogen may be the fuel of the future.

*Fourth Award - ISEF/Microbiology

Guavamycin: A possible plant derived antibiotic for the fight against infections caused by Staphilococcus aureus

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In this second phase of the investigation, the effectiveness of the extract obtained from the leaves of the guava tree (Pisidium guayabo) for the control of the growth of the Gram positive bacteria Staphilococcus aureus will be proved. Also, a profile of the activity versus the concentration of the extract will undertaken.

The antibiotic obtained from the guava tree should have an activity that is in direct proportion to its concentration, as assayed with the pathogenic organism.

Following the inhibition zone method described in the U.S. Pharmacopeia (1985 Edition), different culture media were used to test the growth of the Gram negative Escherichia ccli, and the Gram positive Staphilococcus aureus in the presence of the guava extract.

Utilizing different concentrations of this filtered extract, it was proven that it has inhibitory properties against the growth of Staphilococcus aureus. It was also proved that there is a linear correlation between the concentration of the extract and the size of the inhibition zone.

*Third Award - ISEF/Microbiology

THE P-TRAP, A CONTINUING DILEMMA

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The purpose of the first phase in my research was to determine whether the P-Trap could harbor harmful bacteria. The trap, so designed to keep sewer gas from entering the home, was found to be a reservoir for harmful bacteria. *Morax-Axenfeld bacillus* and *Pseudomonas* were isolated from the trap. Experiments with a number of solutions were tried to determine their inhibition to bacterial growth. Bleach proved to be the best substance; however, it had only a transitory effect.

The second phase of this study was intended to identify other existing organisms in the P-Trap, as well as to determine if anaerobic bacteria were present, and finally, to design a mechanism to control the growth of pollutant substances inhabiting the water.

Pseudomonas aeruginosa, Klebsiella pneumoniae, and *Escherichia coli,* all pathogenic organisms, and *Acinetobacter calcoaceticus var. anitratus,* an opportunistic pathogen were found. These were identifed by the API System. Facultative anaerobes and obligate anaerobes were isolated by means of the candle jar and the GasPak anaerobic system. *Clostridium perfringens,* a pathogenic anaerobe was confirmed in two sites by the Reverse Camp Test. A direct correlation between organisms found in the trap and the identification of individuals infected with the organisms was found.

Continual use of running water in the P-Trap does not wash out the bacteria. A solution to rectify this dilemma would be to attach a tube to a slanted device on the P-Trap's stem through which a disinfectant, such as bleach, would periodically drip.

*Third Award - ISEF/Microbiology

MEDICATED FEEDS - FRIEND OR FOE?

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Since the early 1950's antibiotics have been added to animal feeds after studies indicated that antibiotic feed additives increased the rate of growth and production in farm animals. However, it is now believed by some reasearchers that feeding medicated feeds results in the development of resistant bacteria that could have serious effects.

Dairy calves fed on both medicated and non-medicated feed were randomly selected from the middle and east Tennessee area. Bacteria was collected from the rectal area of these calves using sterile cotton swabs. This bacteria was cultured in nutrient broth and later transfered to the surface of sterile nutrient agar plates and sensitivity tests to tetracyclines were conducted. Almost total resistance to tetracycline was observed on the plates from the calves on medicated feed. However, samples from calves on non-medicated feed were more sensitive to the tetracycline discs. Samples were taken from the plates that showed antibiotic resistance in the area close to the sensitivity discs and colonies were isolated using the streak plate method. API and endo agar tests were conducted on the colonies isolated and E. coli was found to be present.

#First Award - American Veterinary Medical Association

# XENOPUS POWER

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PURPOSE: RESEARCH HAS INDICATED THAT THE AFRICAN XENOPUS FROG HAS THE UNIQUE ABILITY OF PRODUCING A NATURAL ANTIBIOTIC IN ITS EPIDERMAL CELLS. THIS ANTIBIOTIC PROTECTS THE FROG FROM INFECTION FROM SURFACE WOUNDS ,AND THUS AIDS IN THE HEALING PROCESS. MY PROJECT WAS DESIGNED TO EXPLORE THE POSSIBLITY THAT THIS ANTIBIOTIC COULD BE OBTAINED WITHOUT CAUSING HARM TO THE ANIMAL. THREE METHODS WERE USED TO ACCOMPLISH THIS TASK: 1. SCRAPE;2. MUCOUS;3. DEAD SKIN. THE EFFECTIVENESS OF EACH METHOD WAS COMPARED TO THE EFFECTIVENESS OF TWELVE COMMERCIAL ANTIBIOTICS IN DESTROYING BACTERIA. FOUR PURE STAINS OF COMMON PIGMENTED BACTERIA WERE USED . THESE WERE SERRATIA MARCESSANS, MOCROCOCCUS ROSEUS, MICROCOCCUS LUTEUS AND SARCINA AURANTIACA.

PROCEDURE: A SERIES OF STANDARD BACTERIOLOGICAL PROCEDURES WERE REQUIRED TO ESTABLISH MY EXPERIMENTAL FORMAT. THESE WERE: 1. PREPARING STERILE AGAR PETRI DISHES (TRYPTIC SOY AGAR); 2. PREPARING STERILE BROTH CULTURES; 3. REHYDRATING LYOPHILIZED BACTERIA FOR INNOCULATION; 4. INNOCULATING STERILE BROTH CULTURES TO PRODUCE PURE STRAIN CULTURES; 5. INNOCULATING STERILE AGAR PETRI DISHES WITH PURE STRAIN CULTURES OF BACTERIA;6. APPLYING ANTIBIOTIC DISKS (COMMERCIAL AND EXPERIMENTAL) TO THE INNOCULATED PETRI DISHES; AND 7. MEASURING THE SIZE OF ZONES OF INHIBITION TO DETERMINE ANTIBIOTIC EFFECTIVENESS.

CONCLUSIONS: THE RESULTS OF MY EXPERIMENTATION PROVED THAT: 1. THE NATURAL ANTIBIOTIC PRODUCED BY THE XENOPUS FROG COULD BE EXTRACTED USING A METHOD THAT WOULD NOT SACRIFICE THE ANIMAL; 2.; THE NATURAL ANTIBIOTIC WAS NOT AS EFFECTIVE AS THE COMMERCIAL ANTIBIOTICS, BUT DID HAVE NOTICEABLE BACTERIA KILL; 3. FURTHER EXPERIMENTATION USING EXACT MILLIGRAM CONCENTRATIONS OF THIS ANTIBIOTIC MAY UNCOVER ITS TRUE VALUE.

#Third Award - ISEF/Microbiology

STREPTOCOCCUS "A" SCREENING IN THE REEDER PUBLIC SCHOOL

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My project is a three year comparison between two schools that I tested for strep throat. I wanted to see how my data compared to state and national health reports, and how it compared to a neighboring school.

I sent out permission letters to all of the parents of the students that I tested. My first step was to take throat swabs. After this I transported the swabs to the Hettinger Community Memorial Hospital where I streaked blood agar plates and incubated the plates for 24 hours.

My results are as follows: Reeder 1987- 94% of the school tested, 3% of these students were positive for strep throat, two of these students were in one family. Reeder 1988- 88% of the high school tested, 3% of these students were positive for strep throat. Scranton 1985- 93% of school tested, 13% of these students were positive for strep throat, two different families had two children in each positive. Scranton 1988- 20% of school tested, 0% of these students were positive for strep throat.

The drugged choice for strep throat is Penicillin V-Potassium. If a student is allergic to Penicillin, the alternative is Erythromycin.

Conclusions: My data should be regarded as insignificant except as a spot survey. There is no obligation for doctors to treat asymptomatic carriers. There is no need for screening in schools unless there are very unusual circumstances. If one person in a family carries strep throat, it is possible that another person in that family may be carrying the strep throat organism.

# THE PRODUCTION OF LACTIC ACID FROM MONOSACCHARIDES AND DISACCHARIDES AND THE CHEMICAL ANALYSIS OF ORAL BIOCHEMISTRY

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Purposes: (1) To find out what type of sugar (either glucose, sucrose, dextrose, lactose, or maltose) would produce the greatest amount of lactic acid in the mouth. (2) To determine which type of toothpaste or mouthwash is the most effective at inhibiting the growth of oral bacteria, thus retarding the formation of plaque. And (3) to perform various tests to determine an individual's susceptibility to dental caries. Procedure: (1) In order to determine which type of sugar would produce the greatest amount of acid in the mouth, I added 1 ml of saliva to a beaker containing 20 ml of distilled water and 1 g of a type of sugar. I incubated the solutions for 24 hours at 37°C. I checked the acidity of the solutions at 14, 18, and 24 hour intervals using a pH meter. I performed this test on 70 samples of human saliva and 4 pure cultures. In addition to the 5 types of sugar, I also tested 3 artificial sweeteners and 10 chewing gums. I added toothpastes and mouthwashes to see if they could effectively control the production of acid. (2) I performed sensitivity testing of 10 toothpastes and 5 mouthwashes, using the Kirby-Bauer method, on 72 cultures of oral bacteria and 4 pure cultures. (3) I performed tests to determine an individual's salivary rinsing time and bacterial flora count. I used Snyder test agar to determine an individual's susceptibility to dental caries. Conclusion: (1) Dextrose sugar produced the lowest pH reading in 51% of the tests conducted. Equal sweetener and Trident bubble gum produced the greatest amount of acid. (2) Close-up and Signal were the most effective products at inhibiting the growth of oral bacteria. (3) After conducting my testing I determined that approximately 60% of the population are very susceptible to dental caries.

#Fourth Award - ISEF/Microbiology
Honorable Mention - American Society for Microbiology

A STUDY OF FUNGI IN LIBRARY BOOKS

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The first objective of this study was to find the percentage of Baton Rouge library books from five libraries demonstrating fungal growth. Eighteen books from the Middleton Library of LSU, LSU School of Veterinary Medicine Library, Main Branch East Baton Rouge Parish Library and Baton Rouge Magnet High School Library as well as nine books from my personal library were surveyed. The eighteen books from the four major libraries were chosen in three categories, those checked out in the last two years, those checked out within two to four years and those checked out within five to ten years, with six in each category. Each library was surveyed in the month of September and the percentage of fungal recovery was recorded.

The second objective of this study was to demonstrate a fumigant which could eliminate fungal growth on books. Three fumigants were tried on the same six books which were reinoculated and cultured to confirm growth before each fumigant was applied. After five days of fumigation, the books were removed from their bubble, an inflated trashbag, and cultured for fungal growth. Percentage of fungal isolation after fumigation was then recorded.

The results of the survey of Baton Rouge library books were 100% isolation from all libraries except Middleton Library whose percentage of isolation was only 11%. Overall percentage of isolation was therefore quite high at 79%. The common fungal isolates of these books were eliminated by fumigation only with the use of gaseous formaldehyde. Ortho Funginex demonstrated limited success against fungal isolates and Lysol Disinfectant Spray showed no appreciable results against fungal contaminants.

* INHIBITION OF IL-1 DEPENDENT THYMOCYTE PROLIFERATION BY TRANSFORMING GROWTH FACTOR-BETA (TGF-B)

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The growth of cells in culture and in vivo is controlled by many different factors. One of the most potent inhibitors of T-cell proliferation has been found to be TGF-B. Little is known of the mechanism whereby TGF-B causes inhibition of T-cell growth. Most investigators thought TGF-B exerted its suppressive effect by blocking early events in T-cell activation at the level of the IL-2 or the transferrin receptors. My project involves demonstrating the inhibitory effect of TGF-B on thymocytes and determining where in the cell cycle this occurs. Resting thymocytes were activated with PHA and IL-1 and cultured with and without TGF-B. After culturing for various times, inhibition of proliferation was analyzed in several ways: A) morphological changes; B) thymidine uptake as an indication of DNA synthesis, trying to establish the dose and kinetic response to TGF-B; C) DNA analysis on a fluorescence-activated cell sorter to determine where in the cell cycle TGF-B exerts its effect; D) changes in surface receptors using fluorescent antibodies; and E) IL-2 production. My data clearly show that TGF-B inhibits blast formation, inhibits DNA synthesis, is dose dependent, needs only be present in culture 10-15 hours, and arrests the activated thymocytes in G1, blocking entry into S phase. The effect of TGF-B on IL-2 production is unclear and needs additional testing. However, my data clearly show that TGF-B's inhibitory effect is not related to the IL-2 or transferrin membrane receptors as had been previously thought. Though the exact location and mechanism remains to be determined, TGF-B causes inhibition very late in the cell cycle. There is currently much interest in using TGF-B for cancer therapy as well as its potential for use in accelerating wound healing.

*Fourth Award - ISEF/Microbiology

* CANCER AND AUTO-IMMUNE DISEASE LINKING GONADOTROPIC HORMONES TO *SACCHAROMYCES CEREVISIAE*

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The original intent of this study was to create a model viral cell from *Dictyostelium discoideum* and T_4 Coliphage. A model cancer cell from *Saccharomyces cerevisiae* was created also. Experimentally created colony stimulating factors were created of a rat hormone (containing adrenalcorticatropin; ACTH), a moth hormone and a yeast vaccine. They were applied to the model cells to discover if those hormones could successfully increase normal cell growth while inhibiting viral or cancerous growth. Failure of the cloning process caused the experiment to be inconclusive.

During experimental studies with *Saccharomyces cerevisiae*, T_4 Coliphage and Gonadotropic hormones, it was discovered that steroid hormones could successfully remove the cell membrane of the yeast cell causing vulnerability of attack by viral particles. These particles can then successfully enter the yeast altering it into a recombinant viral yeast cell that is capable of both yeast and viral functions. Experiments conducted without the presence of T_4 Coliphage resulted in the removal of the cell membrane and ultimately the destruction of the yeast cell. Therefore, this study concludes that auto-immune diseases are more prevalent in women than men because of the sudden release of monthly gonadotropic hormones causing large amounts of steroid hormones to be released.

Therapeutic agents such as Aspirin, Al Keran, Penicillamine and Vitamin B_6 were applied in both yeast experiments. All were successful in retarding growth except Vitamin B_6, which accelerated growth.

*Second Award - Patent and Trademark Office/U.S. Department of
Commerce/Patent and Trademark Office Society

* SYMBIOSIS IN FORAMINIFERA: SURFACE ANTIGENS AS RECOGNITION MECHANISMS

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Some larger foraminifera maintain endosymbiotic relationships with certain species of diatoms, in addition to feeding on other diatom species. Three studies were performed to determine if specific antigens present on algal surfaces assist these foraminifera in distinguishing endosymbiotic diatoms from edible diatoms. Indirect fluorescent antibody technique was used to study antigenic similarities in ten diatom species: *Fragileria shiloi*, *Amphora tennerima*, *Nitzschia frustulum symbiotica* (Eilat and Palau strains), *Nitzschia laevis*, *Nitzschia panduriformis*, *Cocconeis minuta* (Eilat and Palau strains), *Navicula* sp., and *Cylindrotheca closterium*. Results showed that polyvalent antibodies specific to one symbiotic species reacted strongly with other symbionts, but not with nonsymbiotic species, indicating that symbiotic diatoms have common surface properties which are not shared by nonsymbiotic species. Radioactively-labeled diatoms in a second study were coated with antibodies and fed to diatom-bearing foraminifera *Amphistegina lessonii*. Antibody-coated symbiotic diatoms were digested at higher rates than uncoated controls, indicating that protective surface features were masked by the antibodies. Ouchterlony double-diffusion precipitation was used in a third study to determine the number of antibody-antigen reactions involved. No positive results were obtained in eight trials, presumably because the surface antigens are too large or tightly bound to diffuse through the gel.

*First Award - U.S. Army
Second Award - Patent and Trademark Office/U.S. Department of
Commerce/Patent and Trademark Office Society
Third Award - ISEF/Microbiology
Alternate to London International Youth Science Fortnight Trip - U.S. Navy
Alternate to Scholarship - U.S. Navy

RHIZOBIA : SYMBIOTIC NITROGEN FIXATION

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The purpose of this project was to understand the relationship between the *Rhizobia* bacteria and root nodules they form on legumes and to see if the number and weight of nodules were affected by certain plant features.

The hypothesis was that the number of nodules would be directly proportional to the number of root hairs because *Rhizobia* enter through root hairs. The weight of the nodules would be directly proportional to the weight of the legume because *Rhizobia* use plant sugars for nutrients.

The year-long project consisted of planting four types of legumes and gathering information from different sources. Nodules of clover and beans were studied under microscopes. It showed that the *Rhizobia* bacteria are in the center of nodules. *Rhizobia* life cycle involving the process of nodulation was created from gathered information. Root hairs and nodules were counted in about 500 leguminous plants. Weights of nodules and clover plants were also measured.

Number of nodules was found to be directly proportional to the number of root hairs. Weight of nodules increased with the weight of the clover plant up to a certain growth and then leveled off.

The former discovery is important because more root hairs can be grown with the help of *Agrobacterium rhizogenes*, which would result in more nodules and hence, more nitrogen fixation. Because of this potential application, the experiment was replicated with 200 more clover, *Medicago lupulina*, and 200 of another legume, vetch, *Vicia angustifolia*; the conclusion was reconfirmed.

* DEVELOPMENT OF ANTIBIOTIC RESISTANT MUTANTS IN BACTERIA THROUGH THE USE OF RADIATION

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This research project aims to establish the incidence of antibiotic resistant mutants in Staphylococcus epidermidis and Escherichia coli which have been exposed to varying doses of 1. ultraviolet and 2. microwave radiation. This will permit a comparison between the tendencies of these radiations to induce mutations responsible for antibiotic resistance.

After numerous unsuccessful trials using the gradient agar system of mutant identification/isolation, an effective alternate system was developed and utilized by the researcher:

A 24 hour stock solution of E-coli was placed into 5 containers; 4 were exposed to increasing doses of ultraviolet radiation (Dose 1-4) with the fifth left unexposed as a control. After exposure, all were incubated for 24 hours and then underwent serial dilutions to facilitate reading of results. 1cc of each inoculum was placed into test tubes to which were added increasing doses of 1. Penicillin G, 2. Streptomycin, or 3. Trimethoprim/sulfamethoxazole, (see diagram for further details). These tubes were incubated for 75 minutes after which time 0.001 ml of each tube was plated on TSA W/5%SB. Colony counts from these plates were made after 24 hours of incubation.

This experiment utilizing E-coli exposed to UV radiation was repeated in the same fashion using E-coli and microwave radiation and S. epidermidis exposed to UV radiation. In all trials, the number of mutants resistant to any of the 3 antibiotics utilized, (penicillin, streptomycin, and trimethoprim/sulfamethoxazole) was observed and recorded.

***Third Award - ISEF/Microbiology**
Honorable Mention - American Society for Microbiology

Microbial Characterization of the Sauna

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A study was conducted to examine the endemic aerobic bacterial flora was studied at 4 saunas in 2 facilities. A private athletic club (A) and a hospital wellness center (B) were sampled twice: 16-18 surface sites were chosen by random sampling from the floors, walls, benches, and ceilings. Samples were collected on agar contact plates containing R2A, Blood, MacConkey, and Sabouroud agar after facilities were operational 8-10 hrs. After incubation at $36+1^{o}C$ for 7 days, total colony forming units/cm^2 (cfu/cm^2) were enumerated. More microorganisms were recovered from A than from B. Data showed: 1) areas subject to user-contact (floors, benches) showed the greatest number of organisms recovered; 2) temperature and user load were shown to be independent of one another in their effect on the number of microorganisms recovered; 3) no correlation between the numbers of microorganisms recovered from the men's or the women's sauna and the temperature variables in either facility. Each sauna was evaluated for patterns of bacterial growth. Large numbers of molds were recovered from the men's sauna during each of the two sampling periods. All 4 saunas showed a signifigant increase in bacterial recovery during the second sampling. Morphology and gram stain results were determined. A number of gram-positive and gram-negative bacteria, yeast, bacillus, and molds were evident. Each colony type was isolated and maintained on Blood Agar Base subsequent to identification to the genus and species level. Men used the sauna more often than women regardless of user load: 30 men and 10 women used the sauna daily at A compared to B where 7 men and 1 woman used the sauna daily. Heat settings were variable ranging from 130^{o}F to 200^{o}F.

STUDY TO DETERMINE THE ANTIBIOTIC EFFECTS OF P.SYRINGAE/TO BEANS

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Pseudomonas syringae is a common bacteria found on most all foliage. It is known to produce a lethal phytctoxin called syringomycin. The molecular structure of this phytotoxin has not yet been determined, but research is being conducted in this area. Though abundant, P.syringae mainly affects beans, corn, and stone fruit trees. Syringomycin produces necroses and/or cankers in these plants. Other symptoms include leaf scars, epidermal cracks, and lenticils (especially in peach shoots.)

When cultivated on carbon-containing media, isolates of P.syringae produce a wide spectrum antibiotic. This antibiotic is damaging to many microorganisms. Some of these include representative species of each of the major classes of fungi and several genera of bacteria.

The ways in which this bacteria affects other bacteria was tested through the use of a P.syringae disk. The effects of manufactured antibiotic disks on P.syringae was also determined. A comparison study to determine the effects of P.syringae on typical bush bean plants to literature descriptions was also conducted.

WHY DO WOUNDS OF LEOPARD FROGS HEAL WITHOUT INFLAMMATION?

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The purpose of this project was to determine whether wounds in leopard frogs would heal without inflammation, and, if so, whether this might be due to an antibiotic present in the skin of the frogs.

Under the direct supervision of Dr. Tran, M.D. and Dr. Griffeth, D.V.M., small samples of skin were removed from the ventral side of eleven leopard frogs. The frogs were sutured and placed in their home aquariums. Their healing wounds were observed for three weeks.

Each sample of skin was placed on nutrient agar in petri dishes immediately after the dishes had been innoculated with scrapings made of the home aquariums and of the bellies of the frogs. Penicillin G was placed onto control plates. The reactions of the penicillin G and the skin samples to the bacterial cultures were compared. Morphological examinations through gram stains and fermentation tests were conducted on the cultures to begin identification of the bacteria. Additionally, microscopic and stereoscopic examinations of the skin samples in the bacterial cultures were performed.

All of the frogs healed without any inflammation. After analysis of the data, it was evident that the skin of the frogs did have an antibiotic effect on the bacteria that had been cultured. This data supports research done by Michael Zasloff on Xenopus frogs and suggests further, more sophisticated, research be continued in this area.

SOIL - A SOURCE OF ANTIBIOTICS

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Since the search in the soil for organisms that effect antimicrobial activity is a continuous one, the purpose of this project is to test soil samples for antibiotic activity. The procedure involves three phases. Prior to phase I, a collection of soil was obtained from six states. Phase I began by mixing 480 ml. of sterile water with .1 gm. of one kind of soil in a sterile jar. One cc of liquid was removed from the jar and put into a petri dish containing 10 ml. of slightly cooled Czapek's medium. This procedure was repeated for each soil sample. Phase II required the seeding and cultivating of pure mold cultures by placing a small amount of mold on test tube slants of Czapek's medium and nutrient agar. Preparation of petri dishes with 10 ml. of antibiotic assay agar initiated phase III. The agar was streaked with pure bacteria cultures-Escherichia Coli and Micrococcus Luteus. Following a 10-day period of bacterial growth, a specimen of mold culture was placed in the center of the streaked petri dishes. A control experiment involved the seeding of streaked dishes with penicillium notatum and streptomyces griseus. Results indicated antibiotic activity present in the Texas and Maryland specimens. Bacterial growth was slowed in the control dishes. My conclusion considering these favorable results is that soil appearance does not indicate antimicrobial ability and the range of possible specimens is great. This experiment proves the possibility to control unconquered diseases with virulent and bacterial causes is valid. The application of such findings would be the further testing of favorable specimens for toxicity, sensitivity, stability, and effectiveness.

#Second Award - U.S. Air Force

PHYSICS

HOW EFFECTIVE IS A SUPERCONDUCTER MADE BY A HIGH SCHOOL STUDENT?

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Superconductivity, or the complete disappearance of electrical resistance, occurs as a material is cooled below its critical temperature. Superconductors are far more effective than ordinary electrical conductors because they eliminate the wasting of usable energy.

The purpose of this project is to first determine how difficult it is for a high school student to make a superconductor, and secondly, determine how effective that superconductor is.

The chemicals yttrium oxide, copper oxide, and barium carbonate are ground together in a 1:2:3 proportion. The ground powder is then heated in a kiln at 975 C with a gentle flow of oxygen for 6 hours. The resulting material is ground again and then compressed by a hydraulic press. The disk is again heated in a kiln at 975 C in order to absorb a sufficient amount of oxygen. In order to test the self-made superconducter, it is placed beside a professionally made superconducter and both are cooled down using liquid nitrogen. A sliver of samarium-cobalt magnet is placed over each superconductor. If the magnet floats, the superconductor obeys the Meissner Effect, or the loss of magnetic fields. The height of the magnet determines the strength of the superconductor.

By comparing the two superconductors using the Meissner Effect, it was found that a superconductor made by professionals is a much more powerful superconductor than one which is made by a high school student.

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* An Analysis of the Neutron Energy Spectrum Within a 100KW LWR

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Current information concerning the neutron energy spectrum is somewhat limited, existing via cadmium-covered and bare gold foils, dilute gold and manganese foils, and computer code results. More detailed information is needed to set irradiation schedules for experimental irradiations and accurate determinations of resonance integrals for activation processes. This project involves in-core measurements of the neutron energy spectrum using threshold activation foils of various chemical compositions. The experimental facility being focused upon is the south horizontal access port of a one hundred kilowatt light water reactor. The resulting data from this research produced a very accurate representation of the spectrum which will allow for much more efficient usage of the reactor with respect to the south horizontal access port in particular and the entire reactor in general.

*First Award - U.S. Department of Energy
Fourth Award - ISEF/Physics

RETROREFLECTION

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The purpose of this project is to remove distortion from light that has propagated through some distorting elements. The light source utilized was a metrologic neon laser. Since laser light itself contains some naturally existing distortion, it posed a greater challenge for the retroreflector. Distortion is removed by the reflecting of light through its original path of propagation. Usually when light is directed to a surface, it normally is reflected at an angle equal to the angle at which it was incident on that particular surface. The retroflector scatters the light in all directions. This fact allows for only some of the laser light to be reflected exactly through its initial path of propagation to the retroflector. Therefore, distortion that may have occurred while the laser light made its way to the retroflector is virtually undone resulting in lack of distortion.

Is The Ideal Gas Law Correct

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PURPOSE: To verify the Ideal Gas Law
PROCEDURE: A baggy full of gas was lowered into a pipe filled with water. Relative pressure was found using depth measurements. Absolute pressure was then found by adding the relative pressure to the atmospheric pressure. The volume of the gas in the baggy was found by observing changes in the level of water in the pipe. The volume of the gas in the baggy at each depth was multiplied by the absolute pressure at that depth. Both air and helium were used.
RESULTS: The volume of the gas times the absolute pressure was found to be constant in each experiment.
CONCLUSION: The Ideal Gas Law has been verified for changes in both pressure and volume for air and helium.

CAN BERNOULLI'S EQUATION DESCRIBE THE FLOW OF A SIPHON?

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Bernoulli's equation states that at any point through which fluid is flowing, the sum of the pressure energy, the kinetic energy, and the potential energy of a given mass of fluid is equal to that of any other point.

To prove that Bernoulli's equation holds true for a siphon, a piezometer and a siphon, with six spouts where the piezometer could be attached, were constructed. The height change of the water in the piezometer was measured in mm. The height of each spout was measured to calculate the potential energy. The quantity of water flowing was measured with a stopwatch and a graduated cylinder.

The kinetic, potential, and pressure energies were calculated for each spout. The energies of each point were added, and the sums were compared. The sums of these energies were nearly equal. It appeared that Bernoulli's theorem held true for a siphon.

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IS CHAOS CHAOTIC?

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The Lorenzian waterwheel is a type of waterwheel that, under proper conditions, will oscillate continuously. At first glance, the motion of the wheel appears to be chaotic, although one might infer that the wheel will eventually repeat its motion. The purpose of this project is to first find if the motions of a Lorenzian waterwheel can be permanently recorded. The second purpose is to find if the initial conditions on the system have an effect on the wheel's motion, and the third purpose is to determine the nature of the motion.

I constructed a Lorenzian waterwheel and designed and constructed an apparatus for recording the wheel's motion using a generator and a chart recorder. I did many recordings keeping conditions such as starting position and generator pressure on the wheel constant while varying water pressure and the number of holes in each water receptacle. I finally compared various recordings and looked for specific characteristics or patterns within individual recordings.

I found, from comparing recordings, that the initial conditions on the system have a major effect on the motion of the wheel. Even when I thought I was keeping the initial conditions on the system constant for two separate recordings, the motion of the wheel never began nor proceeded in the same way. I realized that I was not controlling all of the initial conditions nor was it possible to control the conceivable infinite number of conditions. Because of this, the wheel cannot and will not ever follow the exact same path of motion twice. Although the wheel will never repeat itself, I did find specific characteristics within individual recordings that suggested repeatable patterns of motion. This suggests that the motions were not purely chaotic.

*Third Award - ISEF/Physics
Alternate - The University of Alabama in Huntsville Scholarship

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MOMENTUM TRANFER VIA VERTICAL COLLISION

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Demonstrations such as the pendulation toy and billiard balls strung on a horizontal wire have been used to explain momentum transfer from one object to another by way of collision. This study deals with the vertical collisions of "super balls" (used because of their high coefficient of restitution) simultaneously dropped one on top of the other in order to produce a special case of momentum transfer after the initial collision. In attempts to determine how close the upper ball, if much less massive than the lower, can rebound as compared to the theoretical value of nine times the height of the original release. Several different combinations of ball size and number were stacked on a welding rod glued radially to a croquet ball. These arrangements were dropped from 0.5 meters and 1 meter heights. The two combinations which yielded the best results were a large ball, four times more massive than the upper, and a lower ball 12.3 times more massive than the upper. The new height reached by the upper was compared with the theoretical values. These theoretical values were reached by taking the kinetic energy equation (using the conservation of momentum and energy) and converting it into height. In order to achieve results from multi-ball configurations, a height ratio was calculated for an "n" ball system. The final equation used is: $H = (2h - 1)$ where H is the height the top ball attains and h is the height from which the system was dropped. This experiment is still underway, but results so far illustrate the "slingshot" effect being used for space probes which study the planets in the solar system.

SUPERCONDUCTIVITY: SYNTHESIS AND APPLICATION OF A $YBa_2Cu_3O_{7-x}$ CERAMIC PEROVSKITE

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Tremendous strides have recently been made towards finding a room temperature superconductor. Superconductors with higher critical temperatures have spurred investigation into this previously stalemated subject. The objective of my project is to synthesize one of these ceramic pellets and demonstrate an application for it based on its unique physical properties.

After researching to find the $YBa_2Cu_3O_{7-x}$ ceramic composition, I proceeded to test different die designs attempting to yield a mechanically stable pellet from the powdered chemicals. A piston and sleeve assembly with a disk insert was finally used to press the powder into raw pellets. Investigation, testing, and alteration of sintering temperature cycles resulted in a finished pellet that demonstrated the Meissner effect - a sign of superconductivity. The trials indicated that cool down and oxygen absorption rates of the pellets were critical in attaining superconductivity.

A vibration detector was made by using the levitation of a magnet above a superconductor. By detecting the frictionless movement of a magnet in relation to a superconductor, a corresponding vibration can be assumed. I found that a change in the position of a reflected laser image from a radius mirror would occur when the mirror was moved in any direction. By attaching the mirror to the magnet, the direction and magnitude of a vibration can be determined. Although in some cases the movement of the reflected image was the same for two different movements of the magnet, the system can be refined to relate the unique nature of superconductors to vibration detection by using laser light as a three dimensional motion indicator.

#Second Award - U.S. Air Force

AERODYNAMIC FORCES ON VARIOUS OBJECTS

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Purpose The project was conducted to study the basics of the aerodynamic forces--lift and drag--at various subsonic speed in relation to the designs of various objects and airfoils. This included the following experiments: determining the most aerodynamic object among the six objects that are paired to show the characteristics of the different types of drag; examining the effect of varying AOA (Angle of Attack) on the Clark Y airfoil; and comparing the aerodynamic efficiencies of the modified wing designs and the two types of flaps, having the same Clark Y section at various air speed.

Procedure To isolate and measure the two aerodynamic forces normal to each other, a wind tunnel, equipped with a unique aerodynamic balance, was built. Each case of measurement was repeated seven times; the data, excluding the lowest and the highest values, were averaged; and the average value was graphed and compared with the other measurements.

Conclusion The results indicated that the tear-drop shape was the most aerodynamic design; that the friction drag increased the total drag on the long rectangular object; and that the rear-end design is more important than the front design in reducing the form drag. The Clark Y section has its optimum range of AOA between 10.0° and 12.5° at the medium range of air speed; the higher air speed decreased the optimum range; and AOA greater than the optimum range caused the stall of the airfoil. The winglet design and forward-swept wing had lower drag and higher optimum range of AOA tha the conventional design due to the reduction of the induced drag; and the trailing-edge flap was superior to the leading-edge flap in its ability to maintain the higher efficiency.

#Third Award - ISEF/Physics

STROBE LIGHT PHOTOGRAPHY: CAN IT HELP US LEARN?

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Using strobe light photography, I planned to illustrate physical phenomena such as gravitational acceleration, air resistance, projectile motion, standing waves, wave motion, circular motion, storage of energy, elastic and inelastic collisions, and to analyze animated motion such as walking, juggling, and the body movements of a falling cat. I used a professional strobe, a home-made strobe, a 35mm camera, a black background, balls, an air table with pucks, and springs to perform the experiments. From the experiments, I was able to make several conclusions. The gravitational acceleration of falling objects with a low surface area to mass ratio, or low air resistance, is close to that of objects falling in a vacuum. Horizontal displacement of objects does not affect vertical acceleration. A vibrating string produces standing waves with several properties important to the sound produced by string instruments. Waves travel at the same and constant speed in media of the same composition. In uniform circular motion, the centrifugal force is constant. Energy present in a system remains constant if no external forces are applied. In elastic collision, no kinetic energy is lost while in inelastic collision, energy becomes potential. The aspects of animated motion can be seen in minute detail in two dimensional pictures. These aspects can be used for improving sport skills, teaching handicapped people bodily movements, and for learning about motion performed by animals. In industry, strobe light photography is used to see machinery in motion. Most importantly, however, it can help students learn about physical properties.

*First Award - Eastman Kodak Company
Third Award - Society of Photographic Scientists and Engineers

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THE EFFECT OF CRYOGENIC FREEZING ON THE DURABILITY OF A CHAINSAW CHAIN

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The purpose of this project is to study the effect of cryogenic freezing on the durability of a chainsaw chain.

The process of cryogenic freezing consists of a slow descent to -149°C, maintaining that temperature for several hours and then a gradual ascent back to room temperature. Some metals, such as iron, which is a component of steel, show reorganization of some of the Austenite crystals into the Martensite crystals by heating. The cryogenic process turns the remaining Austenite crystals into Martensite crystals which gives the steel more durability.

A Stihl chainsaw chain was obtained and each tooth was coded by engraving a number on the side. The chain was split and one-half of the chain was sent to Applied Cryogenics, Newton Upperfalls, Mass., where it was treated. When the treated portion was returned, each tooth was observed and mapped. The two halves were reconnected and the tests were completed by running the saw chain until it was completely dull. A second, untreated Stihl chainsaw was also run through similar timber until it was completely dull. Both chains were microscopically examined by link and noticeable scars were mapped.

The data was analyzed. Based on this study, cryogenic freezing has a significant effect on the durability of a chainsaw blade.

THE PETAL EFFECT: A SCHLIEREN STUDY OF ETHANOL-WATER MIXING

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In 1986, it was discovered by the author that a drop of around 90% ethanol-water solution placed on the surface of a pool of 50% ethanol-water solution would produce a stable flow pattern while dissipating. Because it resembled a ring of petals, this phenomenon was dubbed the petal effect. The discovery was believed to be original, due to the lack of previous research on ethanol-water mixing, and the difficulty of observing and reproducing the effect. To investigate the petal effect, a collimated light source and a sensitive schlieren system were designed and built. The primary hypothesis was that the effect could be verified as a physical phenomenon; the experimental goal was also to observe and characterize the effect. The region of drop and pool concentrations for which the effect occurred was studied; four reliable combinations were found, the best being an 85% drop on a 50% pool. The most evident features of the effect were: a central drop or ring with outwardly projecting bumps, 1 to 3 rows of petals, and narrow, radial rays. The hypothesis was confirmed by reproducibly photographing the effect with the resolution of 35 mm film. Experiments are currently under way to determine the flow velocities at different points in the pattern. The petal effect is believed to be an intermediate stage in the transition from the laminar, orderly mixing of two similar concentrations to the turbulent, chaotic mixing of two greatly differing concentrations.

*Scholarship - The University of Alabama in Huntsville
First Award - American Association of Physics Teachers
First Award - Eastman Kodak Company
First Award - Optical Society of America
First Award - Society for Photographic Scientists and Engineers
Second Award - ISEF/Physics

FIBER OPTICS AND STRESS

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This was an experiment designed to study the effect of stress on fiber optic line. The specific phenomenon studied here was the photoelastic effect. The photoelastic effect is a stress induced birefringence which is a change in polarization from linear to elliptical of light transmitted through a median.

This was accomplished by launching light polarized at an angle of 45° to the angle of stress onto a fiber optic line. The fiber was placed in a press and subjected to varied amounts of stress in the form of linear pressure. The light was then repolarized at 90° to the original angle of polarization. Light intensity readings were taken as the stress was varied.

It was found that the light intensity varied as the stress varied. The values were plotted on a graph and it was found that they followed a cosine curve which is characteristic of the photoelastic effect. Therefore it was concluded that stress causes optical fiber to exhibit the photelastic effect.

This research applies to all communication systems involving fiber optics because this is a possible form of degradation in fiber optic transmission

*Fourth Award - ISEF/Physics

MEASURING PROPELLER THRUST

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This project deals with measuring the thrust created by model plane propellers of different sizes, design, and construction. A machine was designed and constructed that will spin a model plane propeller at a maximum velocity of 7000 v.p.m. The amount of thrust is determined by measuring the elongation of a set of calibrated springs. Adjunct devices consist of a voltmeter and ammeter to determine the power into the propeller and an optical tachometer to measure the radial velocity (v.p.m.).

A MATHEMATICAL MODEL FOR PARTICLE AND FORCE RELATIONSHIPS UNDER THE SUPERSTRING THEORY.

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This project is a mathematical model for particle and force relationships based on the superstring theory. Group theory is used to mathematically relate forces and particles. Supersymmetry, a math for equatable elements, is also employed. By use of the model, it can be proven that by translating particles and forces into dimensional status and spin, the relationships called for in the superstring theory are possible. One way of repressing the superstring on a large scale is by reconstructing its elementary definitions. Rather than describing the building blocks as points, they are now defined with spin and dimensional status. This project enhances the superstring theory and modifies our outlook on the subatomic scale universe.

* THE CONICAL BORE'S EFFECT ON THE HARMONIC RATIOS.

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In a cylindro-conical tube the ratio of the fundamental frequency to those of the higher nodes are slightly more than the simple 1:2:3, ect., of the theoretical cylinder. On a flute, therefore, the second register is naturally a little sharp to the first, and the third more so. I have made an investigation of the taper of the bore to discover what influence it has over this ratio, what factors are involved, and what alteration is needed to correct the ratio.

***Fourth Award - ISEF/Physics**

* THE EFFECT OF NOZZLE DIAMETER ON ROCKET MOTOR THRUST

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In my project, I set out to determine the relationship of nozzle diameter to rocket motor thrust. I designed and built an instrument that plots rocket thrust versus time using the principle of Hooke's law.

I proceeded to modify the nozzle diameters of Estes B6-0 model rocket motors using standard metal drill bits. The thrust of each motor was measured versus duration of motor burn and the area under the thrust-time curves calculated to determine the total impulse (Newton-sec.). From the total impulse and duration the average thrust of each rocket motor was determined.

The average thrust plotted against nozzle diameter gave a straight line with a negative slope demonstrating that thrust is inversely proportional to nozzle diameter.

*Honorable Mention - National Aeronautics and Space Administration

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THE CONSTRUCTION OF A TESLA COIL

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I constructed the secondary of my Tesla coil by cutting a piece of 4" PVC pipe to 34". Then I threaded the pipe from one end to the other at 48 threads/in on a lathe. Then I wound the coil in the grooves with 1 lb #27 enameled wire and put a wooden plug in the top of the pipe. Then I took a piece of insulating material and drilled a hole through it and ran a bolt through the plug in the top of the coil and attached the top wire from the coil to the end of the screw. I painted the coil with clear acrylic spray. I cut a piece of 6" PVC pipe to 1 ft for the primary. Two plexiglass circles 1 ft in diam with a 6½" hole in the center were placed on the pipe. Then I wound 29 turns on meter lead around the pipe in the direction the coil was wound. This was taped to hold it and the plexiglass snugged against the meter lead. I drilled some holes and put some bolts in the holes for the terminals. I constructed the capacitors and built a frame to hold the glass. There is a glass front and back for safety. The spark gap consists of a cubical of plexiglass to hold 2 adjustable electrodes in the center and provide space for the terminals on the end. I drilled holes in the top for ventilation. I tested the Tesla coil to see if it would light a neon bulb and it did. I also hooked the filament of a clear light bulb to the high voltage side of the secondary and found that voltage sprayed off the filament.

A COMPARATIVE STUDY OF THE VELOCITY AND FRICTION WATER CAN PRODUCE TO SAILBOATS WITH A NEW KEEL

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I have been searching for a perfect Keel for sailboats that can receive less friction from water. Tests were done in a test canal taking in consideration the same distance of one hundred and eight centimeters (108cms) the same weight for all the Keels and using two types of sails. The third sail and the mainsail.

In order to sustain my theory, a Keel was constructed with the same shapes and weight of the Keels C, E, H, and I, the ones that received less friction from the water during the tests realized in my previous study of 1986-87. New research was done based on my previous study of 1986-87.

The results of the tests done showed that Keel X had less friction from the water and it floated more on the waterline during its trajectory. Keel X measured with a chronometer gave a result of forty-three point eight centimeters (43.8 cms) per second in a one hundred and eight cms. (108 cms.) traveled. The Keel X was design with three thin angules in its frontal part that permits the Keel to penetrate less in the water. This facilitates its displacement over the water with less friction, increasing velocity with less power or forces from the wind.

MICRO-BUBBLES AND OZONE BUBBLES IN REDUCTION OF SONAR RETURNS

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In 1986, an unexpected phenomenon occured during an experiment I was conducting on SONAR returns. The SONAR return readings of the bottom of a swimming pool disappeared when the transponder crossed over a plume of bubbles. As a result of the observation, I decided to test whether a bubbling system could cause SONAR blanking.

During preliminary tests of SONAR blanking in a swimming pool, I found that the bubble plume consisted of ozone from the pool sanitizing system. I decided to focus on this and bubble size in my experiments. My experiment was moved to the laboratory where variables could be controlled. In a battery of tests, I altered five variables to find optimal conditions for SONAR blanking. Results were carefully measured and recorded using an electronic sonar recorder. Chemical composition of dissolved gases in the water remained constant throughout the experiment. One exception to this was the conversion of ozone to oxygen.

My finding was that a large dense cloud of bubbles is capable of rendering sonar devices ineffective for detection of submersibles. The bubbles themselves are still detectable as noise. The difference in the shielding effect of ozone bubbles as compared with air bubbles is small. The variation of size of bubbles, however, caused a significant decrease in the sonar returns. Smaller bubbles (less than 1 mm diameter), formed at low pressure (0-20 psi), caused compleate sonar blanking. The shielding effect was found to be uniform for a wide range of sonar frequencies and amplitudes.

#Second Award - Acoustical Society of America
Fourth Award - ISEF/Physics

THE UNIVERSE AND IT'S RELATIONSHIP WITH METAPHYSICAL INFINITY

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Many discoveries presently are becoming everyday, more and more abstract. Mathematics has become a field composed of paradoxes and axioms. Thus, creating much confusion into that which we term the UNKNOWN.

Science is everyday proving correct that which at one time was unimaginable. For this purpose the following project was created. The purpose of such is to unite Universal Laws into one, or into a small group of postulates, and to explain Universal Phenomena.

The final work concluded with seven postulates, which express forms of energy and matter still unknown to science.

Each of these postulates are divided into sub-postulates and theorems.

The following work can only be compared with Universal reasoning. No solid proof is to be employed as for science still has much technology to develop in order to accomplish such task.

Making this whole project theoretical, or abstract, only serves as a pioneering approach for future scientists (with the proper sophisticated technology) to experiment and experience, so it can be put into practice.

APPLICATIONS OF THE MEISSNER EFFECT

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The Meissner Effect (the ability of a superconductor to expel an external magnetic field) and its applications were studied with the $YBa_2Cu_3O_{7-x}$ superconducting ceramic. Using Grant's "Do-It-Yourself Superconductors" (New Scientist, 30 July, 1987, pp. 36-39) and Chen's "Practical Preparation of Copper Oxide Superconductors" (Review of Scientific Instruments, September 1987, pp. 1565-1571) as guides, a procedure for fabricating pellets of $YBa_2Cu_3O_{7-x}$ was developed. This procedure was used to fabricate ten pellets and qualitative evidence (exhibition of the Meissner Effect) indicated that six of the ten pellets contained the superconducting phase. These pellets, along with a pellet made at the University of Wisconsin (Madison, WI) were used to develop and test several applications of the Meissner Effect. These applications included the superconductor separatory apparatus of Dingan, et. al., which uses the Meissner Effect to separate the superconducting $YBa_2Cu_3O_{7-x}$ ceramic from non-superconducting YBaCuO multiphase ceramics; the Meissner Piston/Switch, which uses an electromagnet and the Meissner Effect to imitate the oscillatory properties of the piston and the regulatory properties of the switch; and the Meissner Pendulum, which uses an electromagnet and the Meissner Effect to imitate the behavior of a pendulum. Also, an equation was derived which allowed use of the Meissner Effect to measure magnetic field strength and mass. All of the applications were tested and behaved as expected. With further development, these applications could be implemented in the transportation, automotive, electronics, and superconductivity industries.

Star Wars: (Strategic Defense Initiative)

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Purpose: Determine which weapon, now under consideration for The Strategic Defense Initiative program would actually be used and to demonstrate this weapon to the public show those thing which make it the most logical weapon.

Hypothesis: I believe that Free-Electron lasers can and will be used in the Strategic Defense Initiative program as anti-ballistic weapons (if the program is ever put into affect).

Procedure: First, I gathered and sorted all available information on SDI. From this information I organized a chart comparing all of the weapons under consideration at this time. In the chart, I compared the weapons on the basis of their wavelenght, durability, range, feasibility, ability to be serviced,etc. From the chart I picked the weapon I thought was best and made a model of it showing all of its major componenets.

Results: Free-Electron lasers seemed to be the best weapon, but kinetic energy weapon were much cheaper.

Conclusion: Kinetic energy will probalbly be the first weapons used in the system but in the longrun I beleive that Free-Electron laser be the dominant weapon.

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* PULSED CU PLASMA ARC FOR TRANSVERSE LASER EXCITATION

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This is a continuation of an experimental study of the light emission from the plasma of copper electrodes undergoing an electrical discharge. Several improvements were made on a previously constructed homemade broadband multichannel spectrometer. Copper electrodes were made to generate an arc in varying atmospheric conditions in a special chamber. The chamber was constructed from common materials and was used in the previous study. Modifications now include means for actuating components in the chamber. The program of the current study was to examine the potentially laser-like characteristics of a copper arc in a more controllable AC high voltage discharge. The spectrometer system is now functioning as a very powerful research tool. Significant volumes of data can be analyzed. The effects of helium as a buffer gas have been evaluated. The introduction of a feedback mirror has been noted to increase the light emission at the characteristic copper lines in the green. The copper lines, in particularly at 510.6 nm, were indeed observed to be super radiant. A review is given of the previous work and new experimental results are presented.

***First Award - Vacuum Technology Division of the American Vacuum Society**
Second Award - ISEF/Physics

WATER GLOBULES PHASE II

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113 E. Greenbriar, Vinita, OK 74301

The purpose of the project "Water Globules Phase II" is to determine the electrical strength of the bonding that occurs between water molecules that form water globules. In Phase I of this project, it was found that introducing an electrical field to the water globules would resulted in the elimination of these particles.

The floating of the globules may be attributed to the weak hydrogen bonding of water molecules. An electrical field interrupts this bonding, and the strength of this field gives an approximate indicator to the strength of the hydrogen bonding occurring between molecules.

An electrical field is introduced to the globules by use of two parallel plates. The applied field is gradually increased and the number of globules produced are counted until the strength of the field eliminates all of the globules.

The results show that there is virtually no decrease in the number of globules produced until the electric potential of the field is increased to approximately 400 volts, and no globules are produced at 750 volts.

From the results of the experiment, the strength of the electrical field, and in turn the strength of the attractive forces are calculated. The attractive forces involved in the water globules is no greater than 37,500 volts/meters.

QUASI-CRYSTALS: STRUCTURE AND DIFFRACTION

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The relationship between one-dimensional quasi-crystals and sequences of ones and zeros introduced by de Bruijn is derived. Properties of these sequences are used to derive explicit expressions for the positions of quasi-crystal atoms (Phys. Lett. A116 39 (1986)).

A microcomputer generated one-dimensional quasi-crystal grating is produced, photographically reduced, and the diffraction pattern produced by passing HeNe laser light through the grating is compared with the calculated diffraction pattern (Am. J. Phys. 56 72 (1988)).

An indexing scheme is determined for the peaks in the diffraction pattern of a one-dimensional quasi-crystal. A simple relationship is found between the peaks of high intensity and the peak indexes. An analytical expression is obtained showing the dependence of the peak intensities on the peak indexes.

The structure of imperfect quasi-crystals is investigated. It is shown that phason distortions give rise to the characteristic shifting, broadening, and splitting of diffraction peaks as found in experimental work.

A model of a three-dimensional decagonal quasi-crystal is constructed, its diffraction patterns calculated and compared with the experimentally determined electron diffraction patterns of decagonal Al-Fe determined by Fung et al.

#First Award - ISEF/Physics

FEASIBILITY OF IONIC PROPULSION IN INNER SPACE

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Problem--I am experimenting with ionic propulsion in inner space with the use of ions as a propellant. If my ion propulsion "rocket" works, I am going to compare two rockets of a different size and on varying amounts of current to determine the effects and performance. Does the material from which the rocket is made have an affect? Does the number of tips on each arm or humidity affect the rpm's?

Hypothesis--I predict that ion propulsion will work in inner space and that the rocket engine material will somehow affect the speed. I know that more voltage will increase the rpm's and am quite sure that added tips will also increase the speed. To be honest, before I did any research, I didn't think that humidity would hamper performance at all.

Conclusion--Ionic propulsion does work in inner space. The rocket "engine" material does affect it because of differing first ionization energies. If the added tips are in the form of another radiating arm from the cone, the added weight slows it down, even though there is an increased flow of electricity. When the tips are extremely lightweight and attached to an already present arm, the rpm's are increased because there is a greater surface area of air molecules contacting the numerous tips which are in a fanned-out formation. With this greater contact, the larger number of air molecules can accept the ions faster until the point of diminishing returns is reached. I have found that humidity affects the rocket's movement quite a bit.

SUPERCONDUCTORS, FORMULATION, FABRICATION, & EVALUATION

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Superconductors were formulated, fabricated, and evaluated. Varying the Yttrium content and adding Lanthanum [$Y(1-x) + La(x) + BaCO_3 + CuO$] produced new Superconductors with properties superior to a 1,2,3 Yttrium based Superconductor used as a baseline. The Superconductor formulations were tested by cooling them in liquid nitrogen. A magnet is placed on top of the experimental disk. When the disk superconducts, the magnet floats in the air above it. The strength of the Superconductors were compared without expensive laboratory equipment. The efficiency of the formulation is demonstrated by the height the magnet floats above the sample (Meissner Effect). One sample floated the magnet 25% higher than the baseline sample. Mixes with a small amount of Lanthanum superconducted at top surface temperatures up to 194.5 degrees K (-79 degrees C). This is about 30 degrees K above the baseline Superconductor. Processing time and energy was reduced by about 50%. All Superconductors were made without adding oxygen to the furnace during cool down. Analysis of the Yttrium Barium Copper Phase diagram does not explain the results obtained. A three dimensional model diagram is required to evaluate the area of investigation. Additional experimentation to further explore the Superconductor region represented by the volume in the three-dimensional phase diagram is being done. A video tape explaining superconductivity and showing the development of the Superconductors is presented. The tape shows a floating magnet (Meissner Effect) proving the superconductivity of the experimental disks. Samples have been evaluated for crystal structures by x-ray diffraction at the United States National Bureau of Standards.

#Alternate - U.S. Department of Energy Trip

# OPTICAL PHASE FRONT REVERSAL IN A NONLINEAR MEDIUM

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The purpose of this project was to determine whether optical phase conjugation is possible in a nonlinear medium. Certain nonlinear mediums possess the capability to generate a phase conjugated laser beam by a process referred to as degenerate four wave mixing.

An optical bench was constructed to provide for a four pass geometry inside a glass optical fiber and an interferometer device in which to measure the fringe patterns of the conjugated or regular beams. The glass optical fiber was filled with a carbon disulfide-hexane mixture ((1:1, v:v). The interferometer was used to indicate any disturbances in the laser beam.

A control trial was run in which an aberration was placed after the beam splitter in the interferometer, but before the glass fiber. In this case, the return beam from the glass fiber would "undo" itself through conjugation, whereas a plane mirror would not cause the same reversed beam. The fringe patterns produced by the probe beam, before an aberration was placed in its path, would be the same as the fringe patterns produced when the probe beam is conjugated and reversed through the aberration. The same probe beam differed greatly from the conjugated beam when reflected from a plane mirror through the same aberration, in that it was highly distorted and no fringe patters matched those of the control or the conjugated beam.

#First Award - Ball Corporation
First Award - U.S. Air Force
Second Award - American Association of Physics Teachers
Second Award - Optical Society of America
Fourth Award - ISEF/Physics
Alternate - The University of Alabama in Huntsville Scholarship

# PREDICTION OF MODEL ROCKET PERFORMANCE

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The purpose of this project is to prove that it is possible to estimate the performance of a model rocket before wind tunnel or in-flight testing by using mathematical equations. To do this two computer programs were written. The first program steps through a simulation of a model rocket flight calculating the effects of thrust, gravity and drag. It uses a piecewise linear fit of an engine thrust curve, general data on the rocket's mass and its drag coefficient to find the thrust at any time, the mass lost from burning propellant, the change in velocity and the change in altitude. The second program calculates the coefficient of drag for the model based on the Reynolds number and frontal surface area. Once this is determined, the coefficient of drag can be used in the first program to provide more realistic results. The programs results were then compared to actual rocket flight data. It was the intent of this project to prove that numerical methods can be used to accurately estimate physical phenomena and to prove the usefullness of techniques modeling drag. The programs predicted result agreed with the actual data within a 4% margin of error. This project can be used to select engine sizes for model rockets with no previous performance data available and demonstrates the same techniques used in launches of space-faring rocket vehicles.

#Honorable Mention - National Aeronautics and Space Administration

EFFICIENT POLARIMETER FOR ANALYSIS OF OPTICALLY ACTIVE COMPOUNDS

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Optically active compounds are those whose chemical structures cause them to "twist" polarized light that passes through them. The polarimeter is an instrument useful to scientists for analyzing these compounds. Commercially built polarimeters often use delicate and costly crystals for polarizing filters and expensive colored light sources such as sodium emission lamps. The expense of these materials and the difficulty in obtaining them makes the construction of such a polarimeter impractical for common use. In this study, the researcher has developed a polarimeter using common materials that are easily available. This polarimeter should be as effective as a more sophisticated instrument. In order to study its effectiveness, experiments were performed substituting various color filters in place of a potassium dichromate color filter, whose effects are known to be accurate.

Preliminary experimentation was done to check the effectiveness of the polarimeter by analyzing a sucrose solution with the potassium dichromate filter and checking actual results against expected results. Since this was successful, experimentation continued using substitute color filters for analysis of an optically active sample.

In this study, the most efficient color filters were the Kodak Wratten gelatin filter #22, the Binney and Smith yellow color filter, and the liquid color filter composed of six drops yellow and one drop red food coloring in 50 ml. distilled water.

*Fourth Award - ISEF/Physics
Honorable Mention - Optical Society of America

PRESSURE SLOT INDUCED STALL DELAY

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A pressure slot is a thin spanwise opening on the upper surface of an airfoil through which a thin jet of air is ejected. This thin jet of air adds kinetic energy to the boundary layer which delays it's separation and the stall. The purpose of this project was to approximate the most effective position for the pressure slot. Five positions were chose. The first position was located 3/8 of an inch from the leading edge and each consecutive position being 1 inch further back than the previous one. The pressure slot positions are numbered from front to rear. It was hypothesised that the #2 position would be the most effective in delaying the stall. To test the hypothesis five airfoils were built. The airfoils were identical with the exception of the pressure slot position. A wind tunnel and measuring devices were designed and constructed so that they could measure the lift and drag of each airfoil at angles of attack ranging from 0 to +25 degrees. A pressure system was devised which fed pressurised air into the airfoil from a compressor without interfering with the functions of the measuring devices. The results showed that the #2 and #4 positions had similar lift results and were the most effective in delaying the stall. However, the #2 position produced less drag than the #4 position. It was concluded that the #2 position was the most effective in delaying the stall and that the results supported the hypothesis.

*Third Award - ISEF/Physics

HOLOGRAPHIC INTERFEROMETRY

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Last year I produced split-beam reflection holograms for a science fair project. As I further researched holography, I became interested in the uses of holography in science and industry. Of particular interest was the use of holograms to detect defects and stress in objects. A hologram that demonstrates fringes of interference caused by application of stress to an object is called a holographic interferogram.

A one ton sand tension table was used to eliminate vibrations. Movement of as little as half a wavelength of light can be detected. A helium-neon laser was used to produce the interferograms. The utility room in my home was set up as a darkroom for developing the holographic plates, and my garage was enclosed in black plastic and served as a holographic camera. All appliances and utilities were shut down to eliminate vibrations during the exposure. The holographic plate was loaded into a plateholder. The plate was exposed to capture an image of the unstressed object. Stress was either applied or removed, with care being taken not to move the object. Another exposure of the plate was taken. The plate was developed, bleached, and dried. The areas of the two superimposed images that had been changed appear as holographic fringes when viewed.

I was able to actually record the minute movement caused by the addition of 1.5 ounces of sand to a teacup. This type of microscopic detection is now being used by industry and space exploration. Mathamatical calculations can be applied to fringes to measure the magnitude of the distortion.

*Third Award - ISEF/Physics

FINDING THE SPEED OF SOUND USING RESONANCE

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The purpose for my science fair project is to learn more about resonance and to be able to determine the resonant length of a closed tube for a known frequency. I also used this technique to find the speed of sound in air of two different temperatures.

My hypothesis is that the smaller the tube diameter, the larger the tube length will be. Also, the colder it is, the smaller the wavelength will be.

For my procedure, I set up a stand, put test tube clamps on it, and inserted my plastic hose in the clamps. I then put a canister on the stand so it could easily be adjusted. I put rubber stoppers into the bottoms and put a glass bend into the rubber stopper. I measured the temperature of the room. I filled the canister with water and hit the tuning fork on the bottom of my shoe and raised it above the plastic tube. I then adjusted the water level to find the poing where it resenates the loudest. I did this for nine different tuning forks and on four different diameter tubes. I did this at 20°C and 0°C.

As a result, I found that the smaller the tube diameter, the bigger the tube length will be. Also, the one at 0°C had the wavelength a little smaller.

* THE FORMULATION OF A NUMERICAL MODEL FOR CIRCUIT ANALYSIS OF A MESFET

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The purpose of this two year is to design a circuit model of a GaAs MESFET (Metal External Semiconductor Field Effect Transistor). The three phases of the project include (1) a numerical model of the voltage distribution over the transistor, (2) a numerical model of the DC circuit analysis and (3) a small signal model.

Program 1.2, originally developed in 1986, uses two main loops to calculate the electric potential at each point in an 89 X 9 point matrix. The inner loop utilizes Newton's theory to determine the change of each point during every iteration. The large outer loop computes the deviation for each point from the previous set of calculations. If any point exceeds the maximum set value, then the entire set of points is recomputed using the new values until the matrix has stabilized.

Two other Pascal programs were designed to accomplish the remaining two phases of the study. The DC circuit analysis, Program Current, calculates the values of drain-to-source current using the input parameters of drain-to-source voltage, gate-to-source voltage, and previously calculated governing parameters. The accuracy of this model was determined through a series of statistical analyses comparing the computer generated data to the data collected by the researcher in a hardware analysis. The final model, the small signal circuit analysis, calculates the voltage gain of the device at various frequencies using capacitance and resistance values from manufacturer's data sheets.

The final phase of the project is to combine the three separate programs into one complete working model.

*Second Award - ISEF/Physics

WINDTUNNEL ANALYSIS AND COMPUTER MATCHING OF SPECIFIC GOLFER NEEDS

Wallace, Darryn C., Lake Park H.S., Lake Park, MN 56554
Route 2, Lake Park, MN 56554

The purpose of this study was to find a new and constructive way of matching a golfball to a golfer's specific needs.

Using a windtunnel, lift changes due to dimple number, width, pattern, and spacing were recorded and compared. Also a series of lift and distance tests were taken to determine the differences between differently patterned golfballs. After correlating specific golfball characteristics in flight to lift tests taken in the windtunnel, a computer program was designed and used to determine which golfballs had a 57% or greater match to the golfer's needs.

The lift and distance studies showed that newer golfballs with a larger number of surface dimples coupled with a small dimple width lifted higher than those with a low number of dimples coupled with larger dimple width. Core composition and compression also played an important role in a golfball's flight, too. The higher the compression, the less lift on the ball and the longer its trajectory.

With proper programming, the computer was able to use lift and flight data to find a golfball which could improve a golfer's performance without the golfer changing his stroke or stance in any way.

In future studies, I hope to design and build a golfball which is the most user friendly to every type of golfing situation.

# VISCOUS FINGERS AS FRACTALS

Magde, Laura S., Gompers Secondary, San Diego, CA 92102
3113 Ducommun Av., San Diego, CA 92122

Fractals can be obtained by forcing, under pressure, a low-viscosity fluid into a high-viscosity fluid. This project was undertaken to determine the effect that varying the relative viscosities and interfacial surface tension of the two fluids has on fractals produced in this manner. For part one of this project, the effect of viscosity was investigated. Water was used as the low-viscosity fluid and seven different oils (viscosities .036 poise to .709 poise with surface tensions of 37 ± 2 dynes/cm) were used as the high-viscosity fluids. Part two of this project was designed to investigate the effects of interfacial surface tension. This time, 5W-30 motor oil was used as the high-viscosity fluid in all cases and seven different soap solutions (viscosity .010 poise and surface tensions 29.1 to 72 dynes/cm) were used as the low-viscosity fluids. In each case, the viscosity was determined by timing the rate of fall of nylon beads through the fluid and the surface tension was calculated by measuring the height of a water column in a capillary tube. The factals were then generated using the constructed apparatus and the structured walk technique was employed to calculate fractal dimensions. Ten separate trials were averaged and analyzed statistically for each set of conditions. Both viscosity and surface tension are inherently related to fractal dimensions of fractals produced in this manner. Fractal dimensions proportional to the differences in viscosity and inversely proportional to the interfacial surface tension between the two fluids.

#Glenn T. Seaborg Nobel Prize Visit Award
First Award - ISEF/Physics
First Award - U.S. Army
First Award - U.S. Navy
Second Award - American Mathematical Society
Second Award - Ball Corporation
Alternate to London International Youth Science Fortnight Trip -
U.S. Marine Corps

HOW CAN DIFFERENT PAINTS REDUCE THE TOTAL RESISTANCE OF A SHIP TRAVELING THROUGH STILL WATER?

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3309 Harold Street, Saginaw, MI 48601

The purpose of my project is to find out if the use of different paints on the hull of a boat moving through still water will reduce the total resistance.

I tested 16 models in a tank that was 214 cm. by 40 cm. by 28.5 cm. I conducted a total of 514 experiments. To conduct each test, I pulled the boats through the water with a TYCO train. I measured the tension on the tow line with a spring scale mounted on a trailing car in order to determine the total resistance in each trial.

I tested 4 different finish applications on each boat and determined the total resistance of each. Each paint layer was sanded off before another paint application was made. I used the paints Aero Gloss, 2-Part Epoxy, Anti-Fouling Paint and my control hull had no paint on it.

#Fourth Award - ISEF/Physics
Alternate - U.S. Department of Energy Trip

ATMOSPHERIC TURBULENCE: IS LONG-RANGE WEATHER FORECASTING POSSIBLE?

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Since convection is a fundamental characteristic of weather and is proven to be chaotic, is long-range weather forecasting possible?

This project involved using a custom computer simulation of the Lorenz System, which is a mathematic model of basic convection, to establish a relationship between the predictability of a convection system and the precision of simulated instrumentation. A limiting process was set up so as to see how far one could predict the evolution of a convection system given simulated equipment with a predetermined error.

It was found that as error was decreased by a power of ten, predictability was increased. It, however, was also determined that the degree of increase declined proportionally to the reduction in error. This relationship was observed to be logarithmic. Therefore, it could be construed that in order to obtain an accurate long-range prediction of a convection system which could be directly related to weather systems, no instrumentation error could be tolerated.

Since, to date, perfect instrumentation is not available, long-range weather forecasting remains a guessing game.

CONSTANTS IN THE RATE OF FLOW THROUGH A CHANNEL OF RECTANGULAR SUPPRESSED WEIRS

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The fluid mechanics principle of weir flow is applicable to the flow of wind over a building - the accuracy of which is contingent upon the degree of turbulence in the flow. Experimentally it is found that the turbulence in the flow through a city causes great deviations from the expected behavior of weir flow, however, the consistencies allow for a great many generalizations. Since air deflected upward from a building does essentially follow the same laws governing weir flow, the distribution of velocity on the approach to the building is easily anticipated. The maximum approach velocity for a building must be at a point just below the building's peak or crest. This allows a building's designer to place reinforced window structures at these points where the pressure is known to be the greatest. Given the equation for the final velocity of a streamline deflected from a weir, the designer or architect is able to account for the pressure the wind will exert on objects mounted on the roof of a building. Through experimentation, the average rate of flow over each building in the same channel of flow is found to be the same, even though it clearly could be shown that there was more air flowing above the shorter buildings. This indicates in a channel of flow, the substance in the current moves so as to create a constant average velocity in each region of flow. Applications of this also involve the effect of the distribution of velocity and give further insight into the wind loading of building structures.

FILTERING OUT ULTRAVIOLET LIGHT

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Sunglasses are stylish and fun to wear, but do they protect the eyes? When sunglasses are worn, the absence of visible light causes the eye to expand its iris allowing more vulnerable areas to be exposed to ultraviolet light. An excess of ultraviolet light can cause eye damage and increases the risk of eye disease. The ozone layer in the atmosphere protects us from an excess of ultraviolet light. If the ozone layer is depleting (as recent studies have indicated), then proper eye protection becomes indispensable.

This experiment was designed to find a lens that would protect the eyes by filtering ultraviolet light without filtering the colors of the visible spectrum. In the initial procedure, a prism was used to separate light into its different colors which provided data for this experiment. However, the data was visual observations which excluded invisible light. To increase the accuracy, a spectrophotometer was used to separate and isolate one specific wavelength, and measure the percentage of transmittance of that wavelength after it passes through the sample lens. The spectrophotometer enabled the separation and measurement of visible and invisible wavelengths. Because a spectrophotometer was used, the lenses were tested under uniform conditions and more accurate results were obtained.

#Honorable Mention - American Optometric Association and Auxillary to the American Optometric Association
Honorable Mention - Federal Aviation Administration

2-1 PHOTON ABSORPTION

Simmons, David L., Hilton Head High School, Hilton Head Island, S.C. 29928
5 Gracefield Road, Hilton Head Island, S.C. 29928

The purpose of this project was to determine if a holographic image could be produced by employing the one and/or two photon absorption processes. Further development of this technique could lead to real-time holographic images that could be viewed from any direction alleviating the need for LCD time delay goggles and two dimensional CRT displays. The one photon aborption method used in this project consisted of a PCM Helium-Neon Laser (645 nm),a Kodak Laser Dye, a mirror, aperture, and a beam splitter. The laser beam was projected through the lens, aperture, and beam splitter. One beam continued on its directed path into the laser dye while the other was reflected into the dye. The two photon absorption method consisted of a Spectra Physics Argon-Ion Laser, a Kigre Neodymium-yag Laser (1060nm), a Questex 3-D Infrared Sensor Cube, and 4 prisms. The beam from the Argon-Ion Laser (450nm) was used to excite the cube into the blue spectrum while at the same time aligning the Neodymium-yag Laser. The Neodymium-yag Laser was then used to further pump the phosphors inside the sensor cube into the UV spectrum;the phosphors decayed into the orange spectrum. The production of a holographic image depends on easily differentiating the beams' intersection from surrounding electromagnetic radiations.The one photon absorption method failed to produce a vivid spot when compared to the two original beams. The two photon absorption method produced an orange luminous spot that was easily distinguished from the original beams. The two photon absorption method seems capable of holographic image production if, in future experimentation, it could be coupled with a more sophisticated system using acoustical and computer guidance.However,the one photon absorption method appears unable to produce such an image under any test condition utilized. Successful experimentation in this area would be of great importance to the civilian and military communities.From a circular holographic 3-D theater to 3-D radar simulation and 3-D guidance missle tracking systems to real-time 3-D imaging on the molecular level,holographic imaging would be invaluable.

#Honorable Mention - Optical Society of America

STUDY OF LATERAL ANGULAR DISTRIBUTION OF SECONDARY E^- SHOWERS

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This is a comparative study of various shielding/scattering materials in relation to the lateral angular distribution of secondary electron showers.

Primary electron showers were created in a steel plate, placed above the experimental setup, by high-energy particle collisions, photoelectric absorption, etc. This plate served as a proximate shower source. Different interposing materials were used, providing different secondary shower patterns.

Scintillator/photomultiplier tube apparatuses were placed under these materials. Scintillator emits light when struck by charged particles, and photomultiplier tubes convert these light flashes into electric currents. In the experiment, these currents were then run through coincidence units, which determine whether signals from different tubes occurred close enough together to be from the same electron showers. Trials were taken at successively greater apparatus-separation distances, and thus greater angles.

The results indicated a general trend of greater dispersal in steel shielding as compared with plywood shielding. Plywood/steel tests were inconclusive due to their inconsistent results. However, for all tests, an apparent optimum angle for electron dispersal was found, with a different angle for each shielding material configuration.

INNOVATIONS IN HIGH T_c SUPERCONDUCTORS

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32955. 1287 Rockledge Dr. Rockledge, FL 32955

This project investigates current production methods for high transition temperature (T_c) ceramic oxide superconductors and seeks to develop new, more efficient processing methods. The researcher first established a standard control procedure with which to prepare superconducting samples of Y-Ba-Cu crystal compounds in consideration of the available materials and environment. (Samples were tested for superconductivity using the exhibition of the Meissner effect as in dispersion of magnetic flux as an affirmative indicator.) With acknowledgement of current commercial laboratory methods, a control procedure was established involving the use of grinding, pressing, high-heat firing, staggered cool-down w/oxygen pumping of the kiln, and liquid nitrogen test coolant. The researcher then attempted to affect the linear coherence of the separate crystal chains in the lattice materail by the introduction of a magnetic field on the samples during the formulative period of the staggered cool-down. With the achievement of linear-orriented material, the researcher hopes to have developed samples with an optimized current carrying ability for any any application requiring linear transmission of electricity (at high current density). Such applications benefiting from this effect would be power transmission(long distance), circuitry applications requiring a medium with homogenous conduction characteristics, and precision testing instrumentation.

#Third Award - American Intellectual Property Law Association
Third Award - ISEF/Physics

# A STUDY OF RESONANCE IN DIFFERENT RIGID MATERIALS

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"A Study of Resonance in Different Rigid Materials" explores the mechanics of resonance as produced by forced oscillation. By observing the sympathetic vibration of rigid aluminum, glass, Plexiglass and Lexan plates, the phenomenon of resonance was studied. The experiment identified variables which affected the length, degree, and level of resonance. These variables were: composition, thickness, size, boundary conditions, and mode shape of deformation. The effect of these variables on rigidity was studied. Several unique mathematical relationships between rigidity and resonant intensity were found. An apparatus was designed that vibrated the plates. During resonance, measurements on a sound level meter were taken. The Quality value (Q) was computed for each resonance. This acted as a control for studying rigidity - a new approach based on resonant intensity. The reliability of the results was statistically analyzied. The stiffer the material, the more intense resonance became. As thickness increased, the Q value increased linearly. Decreasing the plate's size decreased resonant intensity. As damping increased, the width of the resonant spectrum widened, but the strength of vibration decreased. The degree of resonance varied with each mode shape of deformation. Rigidity appeared to be a function primarily related to the molecular structure of a plate. The manner in which rigidity affected the Q value depended upon the variable producing the rigidity factor. Using the mathematical formulas derived, it is possible to predict resonant response under several variable conditions. Ways to minimize dynamic vibration of structures can be suggested by applying the information gathered on rigidity.

#First Award - National Aeronautics and Space Administration
Third Award - American Association of Physics Teachers
Honorable Mention - Acoustical Society of America

STUDIES AND DEVELOPMENT OF A LASER BEAM ELECTROMAGNETIC OPTICAL SCANNING MICROSCOPE AND A SCREEN PICTURE CONTROLLING DEVICE

Nagatani, Yukinori, Tsu Nishi H.S., Tsu, Mie 514
273 Haseba-cho, Tsu, Mie 514

The fact that an electron microscope has a scanning mode type,but an optical microscope doesn't, prompted me to do this research of designing and producing an optical microscope with a scanning device.

My research is diveded into two parts: development of 'a laser beam electomagnetic optical scanning microscope' and development of 'a screen picture controlling device'.

As for the former, I managed the difficult task successfully after many experiments. I used semiconductor laser as a luminous source, condensing laser beams through a lense and scanning the focus on the sample with an electromagnet and a reflecting mirror. I detected reflecting lights emitted from the sample. This was the procedure of my research.

As for the latter, I processed the electric signal coming from the reflecting light of the optical microscope and produced a device showing a sample picturescreen on the Braun tube. The device is made up of a number of integrated circuits, and has a resolution of 256×256 dots. It can express 2[illegible]=16,777,216 colors per dot. The operation of this device is controlled by a computer.

Three years of my research mainly concentrated on designing, producing, and experimenting on the device mentioned above. The result shows that I succeeded in displaying the microscopic screen picture, though a low resolution, and establishing the theory of a laser beam electromagnetic optical scanning microscope.

#Grand Award - Patent and Trademark Office/U.S. Department of Commerce/Patent and Trademark Office Society
Third Award - ISEF/Physics

* CYCLOTRONIC ACCELERATION IN AN EVACUATED ENVIRONMENT

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Particles given off in radioactive decay have their own mass and an electrical charge. As a result, the principles of electromagnetism affect the paths these particles take when subjected to such fields. The development of this cyclotron was designed to demonstrate the feasibility of a small, inexpensive model using stationary natural magnets, low power radio frequency oscillation to "dees" located in a vacuum chamber and particle detection using simple, easily obtained equipment. With uranium sulfate rated at one (1) millirem/hour as a particle source, the cyclotron accelerated emitted particles inside the drift tubes at 10.6MHz. Particles ejected from the cyclotron core were detected by both geiger counter equipment and through cloud chamber operation. Testing substantiated that an average of 15.06 particles were ejected from the core per minute into detection devices. Specific technical changes were isolated during testing, with "inboard" detection and a new particle source receiving the most attention. Detection of accelerated particles through film and gas bombardment failed to demonstrate particle passage, as the power output of the core was too low in terms of electron volts to excite film layers or gases. This cyclotron could have practical applications in classrooms for demonstration and analysis purposes.

*First Award - Vacuum Technology Division of the American Vacuum Society

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Correlation Between Theoretical and Experimental Models of a n^+ p p^+ Concentrator Solar Cell

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The purpose of my research was to prove the equations developed by Singh and Singal ("Open-Circuit Voltages Across Two Junctions In n^+ p p^+ Solar Cells Under High Illumination Levels," Solar Cells, (1983) p. 97-123.) using experimental data. In order to do this, the equations were proven to be theoretically correct. Next, I obtained the necessary information from a n^+ p p^+ concentrator cell. I used a computer program based on Singh and Singal's equations to predict the open circuit voltage and short circuit current. I also used the PC-1D program to predict the cell's parameters as a basis for comparison. I found that the program based on Singh and Singal's equations was not accurate. This could be due to a defect in the program or the inaccuracy of the equations. I also found that, because the PC-1D was accurate in its predictions, it could be used for solar cell modeling.

The ability to use a computer for accurate solar cell modeling is very important. With a computer, it is possible to predict the efficiency of a solar cell without actually making the cell. This will eventually lead to more efficient use of solar power. This is important because of the world's energy crisis.

IS THERE EVIDENCE OF THE EXISTENCE OF A FIFTH FUNDAMENTAL FORCE OF NATURE?

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The purpose of this research is to gather evidence concerning the existance of a fifth fundamental force governing the workings of the universe. This force, if found, would slightly counteract gravity on some substances. The existence of this force was tested by dropping various metals attached in pairs from an altitude of 27 meters. Four metals were used: brass, copper, steel and aluminum. The frequency of landing as the metal on top upon impact was recorded. If the fifth force exists, it would repel the more dense metal more than the less dence metals making one side land up more frequently. After the data for 100 repeated trials was tabulated, a statistical test was used to compare the results to probability. Significant evidence of the fifth force has been found to exist in at least one of the combinations of the metals as indicated by this statistical test. If evidence supporting the idea of the fifth force is consistently found by many groups of reseachers, the fifth force theory may be proven. If proven, it could lead to a grand unified theory of matter.

Which One Wins the Gold

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Different people have their own opinion about which type of .22 bullets are the best. I did this project so that I could determine which one really is the best, or if there is any measurable difference in their performance.

Different types of bullets were obtained and five of each kind were fired through four different rifles. The bullet was shot through a chronotach machine (an electronic instrument that calculates the velocity of the bullet). I then took averages of Extreme Spread, Standard Diviation, Average and Maximum velocity.

I found out that the Remington High Velocity is probably the best bullet because it is fairly fast and shoots the most consistently. The Stinger was the fastest bullet but it was not very consistent. The Blazer is the slowest bullet and has poor consistency.

ANGULAR VELOCITY VS. ANGULAR DISPLACEMENT

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The purpose of this study was to prove that the peak angular velocity of a gymnast's center of gravity will increase with each wind-up giant swing on the horizontal bar. The gymnasts were filmed from the side at 50 frames per second. The data was then graphed. The results showed that the peak angular velocity of the wind-up giant swing was form 5 to 43 degrees higher than the peak angular velocity of the regular giant swing. Thus, it can be concluded that there should be a gradual increase in the peak angular velocity from one wind-up giant swing to the next, reaching a maximum in the dismount giant swing.

IS THAT THE WAY THE BALL BOUNCES?

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It is the purpose of this project to explore the theory behind the following equations, $h = v_i t + 1/2gt^2$ and $v_f = v_i + gt$, and to demonstrate their validity in an actual situation.

The foundations of these two equations are deeply rooted in physics and calculus. If one begins with the assumption that $a = g$, velocity can be found by taking the integral of this equation with respect to time, which yields $v = gt + v_0$, where v_0 is the velocity at time 0. Height or position can then be found by integrating the equation for velocity: $s = 1/2gt^2 + v_0t$. Once a student understands the thought processes behind certain equations and principles, the equations and principles usually seem much less intimidating.

A second method of illustrating equations involves actual physical demonstration. A small rubber ball was filmed bouncing in front of a grid with gradations of 0.01 m, or 1 cm. After calibrating the time involved in the experiment, height vs. time data were recorded using the PAUSE and FRAME ADVANCE features of the VCR camera. This data allowed for the calculation of a fairly accurate coefficient of restitution for the ball. The coefficient, along with the height from which the ball was dropped, was given to a PASCAL program which generated theoretical values for height and time using the above equations. Comparison graphs of average and theoretical trials were then made to better show the similarities between the two sets of data. The graphs clearly demonstrate the validity of the equations within reasonable limits of human error.

SUPERCONDUCTIVITY

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The purpose of this study was to make a ceramic superconductor, to investigate the role of oxygen on the ability of the material to superconduct, and to measure the change in resistance as a function of temperature. Two pellets were prepared using an yttrium barium copper oxide material, $YBa_2Cu_3O_7$. One of the pellets was prepared from a mixture made with the addition of water as an oxygen source, while the other mixture remained dry. Both were baked and then tested for the Meissner effect, an indication of superconducting state. Only the pellet prepared with oxygen demonstrated the Meissner effect and was therefore used in the subsequent test. The sample was cooled using liquid nitrogen, and slowly heated with a constant current input. Graphs of resistance versus temperature were plotted. There was a sharp drop in the resistance at a temperature of 83 K. This would indicate the transition temperature. The results of this study would appear to indicate that the material tested was a superconductor with a transition temperature of about 83 K. The addition of oxygen appeared to improve the ability of the material to superconduct.

ZOOLOGY

* INFLUENCE OF TAGETES AND LOLIUM MULTIFLORUM ON MELOIDOGYNE INCOGNITA

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Two separate experiments were conducted to determine the effects of Tagetes (marigold) and Lolium multiflorum (ryegrass) on Meloidogyne incognita, a plant parasitic nematode. Both were designed to study the effects of treatments on nematode population densities and host plant development. The first test dealt with decomposition residues of marigold and ryegrass. Plant component treatments consisted of plant roots, stems, flowers, a combination of all above ground parts, as well as living marigold and ryegrass plants. The second test dealt with soil containing root emanations from marigold and ryegrass. Soil containing root emanations from the plants was combined with a sand soil mix (1:1,v/v) to acheive a 0, 25, 50, 75, or 100 percent soil mix. Micropots containing one tomato host plant each were uniformly infested with 10000 nematodes/pot in both tests. Decomposition residues of all plant components significantly reduced the number of second stage juveniles. Nematode populations decreased as percent concentration of root emanations were increased. There were no adverse effects on host plant development.

*First Award - ISEF/Zoology
Second Award - American Phytopathological Society

* CORRELATIONS BETWEEN HABITAT QUALITY AND FAT DEPOSITION IN CASTOR CANADENSIS

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During the Summer of 1987 I collected data on beaver habitat and dwelling types in Michigan's Western Upper Peninsula. This field work noted that not all beaver habitats are of the same quality. Site quality ranged from poor to fair to good depending upon the type of food available (a sampling of the vegetation around each beaver lodge or burrow was done). Beaver are total herbivores and depend entirely upon the close proximity of certain plants to their dwelling sites. Beaver trapped (by a registered trapper) from this study area later in the fall revealed considerable variation. 53 beaver specimens were obtained and data regarding age, weight, tail length, tail width, tail mass, and tail volume was recorded. Chemical analysis of the fat in selected beaver tails was also done to determine the total percent fat. My research hypothesis states that there should be a positive relationship between habitat quality and the quantity of fat deposited in each tail. Although much of my data supports this hypothesis, it is still unclear exactly how significant this relationship is in all cases studied. Because of the nature of biological field work it is often difficult to minimize the role other factors play in affecting the outcome of the investigation. To extend this investigation a controlled experiment could be designed to either verify or disprove my initial hypothesis. This experiment would be difficult to implement however, since it is against the law (except under special conditions) to keep beaver under laboratory conditions.

*Honorable Mention - American Statistical Association

THE EFFECTS OF ULTRAVIOLET LIGHT ON THE REGENERATION OF PLANARIA

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The purpose of this experiment was to try to determine if there is a link between the regeneration rate of planaria and exposure to ultraviolet light.

Two hundred and ten planaria were separated into thirty groups of five planaria each. The experimental groups were exposed for times varying from ten to thirty minutes.

It was observed from the results that the regeneration rate was slowed considerably after the planaria were exposed to ultraviolet light and allowed to regenerate.

#Scholarship - The Ohio State University

VECTORS CONTROLS:A COMPARATIVE STUDY OF THE EFFECTS OF ELECTROMAGNETIC WAVE IN BIOLOGY ASPECTS OF INSECTS.

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Each years, billions of dollars are spent in E.U. for the control of vectors, but the results of the efforts to control these plaques in the world,don't justify the cost.The following study presents the effects of wave in biology aspects of four vectors.The insects were radiated with seven radiation.They will carry through the test of growth, reproduction,sterilization, lifespan, morfology, behavior,color preference,feeding preference resistance,resistance in enviromental aspects, crosses for the resistance and other aspects of the insects.

In finishing this investigation, it was determined that high radiations and low radiations can be used for the control of vector in entire countries. Besides that, they can be used to lessen the resistance against insecticides developed for the insects. In this way, the population of insects in entire areas will belessened with the desired percentage because of the people that developed the method in this investigation.

INTRA-SPECIES DIFFERENTIATION USING ISO-ELECTRIC FOCUSING OF PGI

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Iso-electric focusing is an exact process, through which such minute differences can be seen that it becomes possible to differentiate between animals of the same species. This I have done with Mule Deer using the enzyme P.G.I. The process is simple but time consuming. Upon obtaining and preparing the samples in a soak of distilled water, the sample liquid is placed on a p.h. gradient plate. An electric current is passed through the plate and the particles (enzymes, protiens, etc...) are focused into bands, which are detectable upon development. Total time for a test is approximately three hours. By studying the said bands, differences can be observed and recorded for further use. This process can be used extensively in cases where the Fish and Wildlife Department is investigating deer poaching or the like in protected area or private preserves, and may also be an additional aid in geographic taxonomy studies.

THE EFFECT OF SUBSTRATE SURFACE AREA ON THE WINTER AQUATIC INSECT POPULATION IN THE UPPER WEBER RIVER

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The relationship between substrate surface area and populations of winter aquatic insects in the upper Weber River in Summit County, Utah, was determined. Insect orders collected in this study were Trichoptera (caddisflys), Ephemeroptera (mayflys), Diptera (midges), and Plecoptera (stoneflys). River substrate rocks were selected for collection purposes, and insects on the rocks were brushed into a Serber sampler net and preserved in jars of alcohol. The surface area of each rock was calculated with a BASIC computer program using three measured dimensions taken from each rock. Substrate rocks were then placed in one of three general size classifications, small, medium, and large.

The average number of insects per rock increased with increasing substrate surface area in a linear fashion. The proportions of each insect order collected from each rock size were very nearly equal. When number of insects of each order versus substrate surface area was graphed, the Pearson's Correlation Coefficients for all four graphs fall between .992 and .999, showing a strong linear relationship existing between substrate surface area and insect populations. Winter insect populations in similar stream conditions can be estimated for any substrate surface area using the equation I=KA+C (insects = constant x surface area + adjustment) with a different constant and adjustment for each insect type.

THE SPAWNING AND EARLY DEVELOPMENT OF PALOLO (Eunice viridis)

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This research is on the spawning and the early development of palolo. Palolo is a sea annelid which is a sea worm. The scientific name for palolo is Eunice viridis. From the literature I gathered, palolo is found in the Samoan Islands, Fiji, Tonga, the Cook Islands, the Solomon Islands and some of the New Hebrides Islands. The palolo spawning in samoa, occurs during the three evenings of the third quarter moon in October and November. Palolo has four stages of development: the embryotic, larval, juvenile, and adult stages. The adult palolo occupies tunnels in massive blocks of coral limestone. On the night of the spawning, the adult palolo comes out of its tunnel and releases its epitoke (the region of the worm that contains gamete or cells that are capable of participating in fertilization). The epitoke is then carried by waves and currents towards the shore. The gametes are released and the fertilization of the eggs begin. After the eggs are fertilized, they undergo cell division, develop into larvae, and sink to a suitable substrate. The anotokal, the region of the worm which stayed in the coral during spawning season, regenerates its epitoke and stays in the coral until the following spawning season. You may distinguish the sex of the palolo by observing the color of its epitoke. The palolo with the green epitoke is female, whereas the palolo with the red epitoke is male. By observing the early development of palolo, the author found one condition of developing that made palolo unique from some other sea annelids. This was the rapid development which the palolo had undergone. This fast development may be the result of environmental conditons needed for the survival of palolo.

* A FOUR YEAR STUDY OF THE EFFECTS OF NOISE POLLUTION ON APIS MELLIFERA

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My fourth year of study will show how noise pollution affects the Apis Melliferas normal detection of colors. Before the completion of the experiments, it was thought any noise pollution near the honeybee while it was gathering nector for the hive would confuse the bee, altering its normal sight and detection of colors. Many experiments were conducted in order to prove that hypothesis true. First, squares of different colors of cardboard were placed on a table. Empty saucers were placed on each square. The saucer on the blue square was filled with sugar water. One bee arrived at the saucer containing sugar water. At that time, a touch of white paint was placed on the bees back. This dot of paint would allow for easy detection if the bee returned. After the bee flew away, the saucer with the sugar water was moved to a red square. The white painted bee was observed to determine if it would go directly to the saucer on the blue square or if it would visit each square to find the sugar water. This was done with each color to determine which colors the bees can recognize. In the second set of experiments, a radio was placed next to the platform and the same procedure was followed. The volume of the radio was producing a high level of static noises. After checking over the data, I found that noise pollution affects the bees normal sight of blue, yellow, gray and black; while their detection of red and white remained the same.

*First Award - Entomological Society of America
Honorable Mention - Acoustical Society of America

NEW DATA FOR THE SUBSCRIPTION OF PUPERITA PUPA

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Puperita pupa (Linne, 1767) presents great poligromatism, that is a variety of coloration pattern. We want to verify if this is an index of a possible subspeciation.

Four different patterns, classified as A,B, C, and D were selected they submittted to a series of tests to verify the original hypothesis.

The morphological approach indicated that patterns A,B,C, are greater in weight and dimensions than pattern D.

Behabioral tests were carried out. In the light test all patterns tend to prefer darkness in geotoxis test, all the patterns tend to climb avoiding the effect of gravity.

To determine if the spiral of these shells had suffered any variation a flat spiral ($e=a\phi$) for it was found.

All the data was analyzed; average and standard deviation were determined. The test demonstrated that there is no significance in relation to the biochemical tests. However in the morphology there exist marked differences in patterns. There is a variation even of a 50% between patterns A and B, besides a variation of 25% between A and C. Patterns B and C are completely different. Pattern D reflect a 100% difffence when compared with the other patterns.

The test tells that in the ecuations of the spirals the constants are similar for all the patterns. A <—> D and B <-> C. Even though there was found a difference in size there is no variation in the construction of the shell.

This permits us to infer that it is possible a subspeciation based in morphology, indicating that no organic variation has emerge in this process.

* CIRCADIAN HORMONAL SYNERGY AND CRUSTACEAN MOLTING FACTORS AS REGENERATIVE CONTROLS

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This project investigated the hypothesis that temporal synergy between analogous hormonal products controls invertebrate morphogenic processes. Further, that these control mechanisms are conceptually analogous to the temporal systems for metamorphic control in the lower vertebrates. The effects of the hormones thyroxine and prolactin, as well as Crustacean Y-organ, X-organ, Subesophageal ganglia, White Region and Brain extracts on the regeneration of periodically dissected planaria were determined. Also the regenerative impact of temporal synergy between the Crustacean Y-organ and X-organ extracts, the Y-organ and white region extracts, and the hormones thyroxine and PRL was assessed. First, .004 ug of thyroxine, PRL, and all extracts were administered to worms periodically dissected at the 2,8,14 and 20th hrs. of their circadian rhythms. Then,worms dissected at the 20th hr. were exposed to a circadian surge of Y-organ extract at the 2nd or 18th hrs., followed at either the 2,10 or 18 hr. interval by a surge of X-organ or later white region extract. Similar tests assessed thyroxine-PRL temporal synergy. Surge controls for each hormone or extract and surge period accompanied the tests. All extracts, as well as thyroxine and PRL exerted regenerative effects linked to the worm's dissection period. In all cases of temporal synergy systems, an inhibitory regenerative impact resulted when a period of 8-16 hrs. was alloted between the two hormonal or extract surges, and a relatively stimulatory impact occurred when the initiator and inhibitor surges were simultaneous. This effect occurred regardless of the time of the initiator surge and appears control-independent. Temporal synergy between analogous hormonal rhythms may provide seasonally linked, efficient control mechanisms for regeneration and molting in the invertebrates.

*First Award - U.S. Army
First Award - U.S. Navy
Second Award - ISEF/Zoology

EFFECTS OF THYROXIN ON THE LEVEL OF CYCLIC AMP IN REGENERATING DUGESIA

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Dugesia tigrina, the fresh water planaria (Turbellaria:Platyhelminthes) have been shown to have remarkable capacity to regenerate its lost parts. Results of experiments done during 1984-1985, and 1985-1986 on the rate of growth of the planarians grown in different media --- calcium, calmodulin, thyroxin, and propanolol have shown that only thyroxin enhances the rate of growth of worms cut into equal halves, compared to worms grown in the other media. Studies were extended this year (1986-1987) to determine whether there is any significant changes in the levels of cyclic 3'-5' adenosine monophosphate (cyclic AMP) produced in the worms grown in the presence (experimental) or absence (control) of thyroxin-containing medium during the regenerative process. The concentration of cyclic AMP in the regenerating worms at intervals of 3 days, up to Day 15, was determined by a competitive binding assay using unlabelled cyclic AMP. The amount of labelled cyclic AMP-protein complex formed is inverseely related to the amount of unlabelled cyclic AMP present in the assay sample. The levels of cyclic AMP at different stages of regeneration was then determined by comparing it with the standard. Thyroxin treated animals on the 6th day showed a six fold (18 picamole/mg protein) increase in cyclic AMP, compared to the control(3 picamole/mg protein). These results support the role of cyclic AMP as a second messenger in planarian regeneration, in the presence of thyroxin.

INCIDENCE OF PARASITIC INFECTIONS IN DAIRY COWS

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Little or no information is available to determine whether there is a need to employ a regular deworming program for dairy animals raised under dry-open lot confinement systems or other management systems. This study was designed to determine the level of internal parasite infection, specifically roundworm and liver flukes, in dairy animals raised under various management systems in Hawaii. Three of the most prevalent systems in Hawaii are: 1) a totally penned confinement system (dry-open lot) without a deworming program, 2) a mixed system of dry-open lot and pasture grazing during the non-lactating (dry periods), with deworming at calving and 3) a pasture management system with a regular deworming program. Results from my survey indicated that animals raised in a dry-open lot system without deworming had the least incidence of parasitic infection while animals raised under a pasture management system had the highest incidence of internal parasite infection. The infection rate by roundworms was assessed at less than 13% for dairy animals reared under a dry-open lot confinement system as compared to greater than 66% for animals reared under the pasture management system. A similar result was obtained in assessing the incidence of liver fluke infection, with 0% for animals reared under the former system and 100% for animals reared under a latter system. Hence, a regular deworming program is not necessary in the dry-open lot management system but is necessary for a pasture management system.

#EFFECTS OF SELECTED SUBSTANCES ON MESOCRICETUS AURATUS

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The purpose of this project was to determine if through the controlled experiments and research of gathered data that a determination could be made as to the effects of selected stimulants, depressants, hallucinogens and narcotics on the maze learning ability and behavior of Mesocricetus Auratus. Through a four year study of training each year, a group of Mesocricetus Auratus to run both the simple and complex maze and then observing behavior and timing the ability to run the mazes and recording the gathered data in a daily journal and keeping graphs on the time required to run the mazes a comparison could be made between the subjects befor and after being administered the selected substances, the control subjects and the the prior year's study. Information was recorded also in a research notebook and a statistical report. Physical proof was attempted to be shown by running EKGs on this years subjects before and after the selected substances were administered. The conclusion being that through carefully controlled experiments a determination can be drawn on the effects of selected stimulants, depressants, hallucinogens and narcotics on the maze learning behavior and ability of the Mesocricetus Auratus.

#Fourth Award - ISEF/Zoology

B_1 DEFICIENCY IN MUS MUSCULUS, PHASE III: GESTATION

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My problem was: Does B_1 deficiency during the gestation period affect white mice in weight, appearance and behavior? My hypothesis was mice on a B_1 deficient diet will show significantly different weight gain, appearance and behavior during the gestation period compared to control mice. After completing a literature research, reviewing my findings from Phase I and II, discussing Phase III with veterinarians and researchers, I obtained twenty white mice. I divided the mice into four groups: control male and female and experimental male and female. I fed the experimental group a diet deficient in vitamin B_1. The control was given a B_1 supplement. The animals were observed daily for changes in appearance and behavior and weighed weekly. Once the signs of the B_1 deficiency were apparent in experimental mice, all mice were grouped into breeding pairs. Observations of appearance and behavior continued as did the recording of weight. All the B_1 deficient experimental mice were placed on a B_1 enriched supplemental diet to reverse all deficiences. As was observed in Phase II, once the experimental animals were given the B_1 supplemental diet, recovery from the deficiency occurred rapidly. Eventually, an untrained observer could not distinguish the experimental from the control group.

My hypothesis was partially correct. I observed several visible differences between the two groups and their offspring; the experimental mice exhibited patchy coats, edema and cartwheel, circling motion. Muricide was observed only in the experimental group. Cannibalism of the offspring was seen in both control and experimental mice. There was little significant difference in weight gain in comparing the two groups.

\# DEVELOPMENTAL ALTERATIONS INDUCED BY COMMON PRESERVATIVES ON DROSOPHILIA MELANOGASTER

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The widespread use of preservatives in today's food has caused much questioning of the safety of these chemicals. To test the mutagenic and population affects of common preservatives on Drosophilia melanogaster, five dosage rates beginning two increments below and continuing to two increments above normal levels of preservative use were set up. Dosages were prepared by adding an amount of chemical, consistent to a percentage of the weight of the total medium,which was thoroughly mixed throughout the medium. Constant and initial groups were also set up. The constant group fed on medium containing preservatives for the duration of three generations. The initial group was cultured under experimental conditions for one generation and then returned to control medium for the remaining two generations. Deviations were observed in all cultures tested. Increasing dosage rates showed a direct relationship to the increasing amount of changes observed. Many alterations were also observed between the initial and constant groups. The constant group showed a continual loss of population, while the initial group regained population after the first generation. In addition to mutagenic and population alterations caused by all dosages of preservatives, hatching dates were also consistently altered in all vials cultured under experimental conditions.

#Fourth Award - ISEF/Zoology

*HOW FROGS SURVIVE SUB-ZERO TEMPERATURES

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This is a study of the effect of sub-zero temperatures on the Northern Leopard frog (Rana pipiens) and their ability to survive freezing temperatures. The Northern Leopard frog as well as other cold climate frogs can survive the freezing of their bodies for periods of over two days and -10°C temperatures by increased glucose levels in the blood. Glucose acts as an antifreeze that lowers the freezing point of water within body cells. Experiments have been performed that found the glucose levels to drastically increase when sub-zero temperatures were encountered. Tests were also done with liver tissue that determined there was an increase in a certain enzyme which aids in changing glycerol to glucose in the liver. The final stage of testing involved the activity of the steroid hormones, glucocorticoids. The glucocorticoids are known to effect gene activity in the liver. In the 60 frogs that were used in testing over a three year period, it was found that these frogs do use high amounts of glucose during freezing temperatures and that the polyol dehydrogenase enzyme increases in activity to aid in gluconeogenesis. The glucocorticoids seem to be the overall controlling factor needed for survival. The hypothalamus in the brain stimulates the pituitary gland; the pituitary in turn stimulates the adrenal cortex which releases the glucocorticoids. The glucocorticoids travel to the liver where they cause DNA to transcribe and RNA to translate to form the necessary proteins which are necessary to make the enzymes such as the polyol dehydrogenase for gluconeogenesis. The glucose is then produced and circulated throughout the frog's body to be used a cryoprotectant.

*First Award - ISEF/Zoology

* Computerized Microscopic Identification of the Integument of Birds

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Past studies of feather identification have centered on the total morphology of feathers. This is an attempt to identify feathers based entirely on node structure and node density on the feather barbules. An attempt was made to utilize a computerized microscopic (compuscopic) approach to the identification of feathers. A computer was used to yield a probability of match for test feathers. This value was based on the average node density of test feathers compared with statistics of average node density made on a larger number of known feather types. The probability of match would then yield confidence levels to disclose the degree of certainty that a particular feather is identified correctly. Ten birds were chosen for this study. These birds were chosen to exhibit a wide variety of species including game, preditory, waterfowl, domestic, and exotic fowl. The computer program appears to have the potential to: (1) give a numerical degree of certainty to an identification (2) to eliminate the identification of feathers outside the range of confidence levels and (3) in the case of several overlapping probabilities of match to allert one to consider these feathers as possibilities and to enter more test counts to decrease the interfering probabilities. By computerizing the results of node density one would not need the high degree of training in recognizing node shapes. One could merely determine node densities for an unknown feather, enter the results into the computer program and immediately obtain a degree of certainty for feather identification.

*First Award - Eastman Kodak Company
Second Award - ISEF/Zoology

SONIC WARFARE ON BUGS

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One problem facing the food and health industry involves the use of pesticides. My goal was to find a way to prevent insect infestation without using pesticides. Since granaries have difficulties in dealing with insects, and grains are basic ingredients for most food products, Tenebrio molitor was chosen for testing.

Testing in previous experiments indicated that sound was effective in disturbing the insects. This project was to show that ultrasound would definitely detract these pests. This idea was sparked from a national advertisement about a device that uses ultrasound to get rid of insects. With this idea in mind, ultrasound tests, including a hearing test and an oscillator test, were conducted on the mealworms. The experiments showed that the mealworms were not affected when exposed to frequencies above 4,000Hz. When the experiments were completed, it was decided that the sound frequencies were so high that they had no effect on the insects. This indicates that the device does not work on mealworms, and probably would not work on other insects as well.

Since my hypothesis was proven wrong, as far as ultrasonic frequencies are concerned, future experiments will be conducted to find out the frequencies of sound that affect these insects the most.

THE ALTITUDINAL MILLIPEDS (ARTHROPODA: DIPLOPODA) OF PUERTO RICO

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A study about the systematics and the population Biology of the altitudinal millipeds of the island was done in the Carite Forest at Southeastern Puerto Rico. This area was selected because its peculiar composition of nine different types of ecosystems within the lifes zones known as lower Montane moist forest (Ewel and Whitmore; 1973) and subtropical moist forest (Weaver; 1974). During three years of research specimens belonging to seven orders, 11 families, 12 genus and 13 species of millipeds have been found. These numbers represent 28% of the species reported for Puerto Rico, 26% of the endemic species and 20% of the non-endemic for the island. All of the species (100%) were found within forestal areas in comparison with 46% found within under deforestal areas which represents a similarity of 63% and 37% of dissimilarity using Sorensen Model (Sorensen; 1948). In terms of microhabitats, 38.46% of the species are ground-living 27.07% are tree-living and 38.46% are both of the preceding. Morphological studies reveal that the following species are polymorphic in several characters: Ricodesmus stejneri, Spirobolellus marmoratus and Spirobolellus richmondi. An ecotypic differentiation is described for Spirobolellus richmondi and Rhinocricus parcus. New zoogeographical localities are reported. The Poratioides virginalis specie was reported for the first time in Puerto Rico representing a new taxonomic record. A hybridization zone between two Prostemmiulus species were reported.

* DNA ANALYSIS OF MAGAININS IN AMPHIBIANS: EVOLUTIONARY IMPLICATIONS

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Magainins, antimicrobial peptides, have been found in the skin of one species of frog, *Xenopus laevis.* The purpose of this project was to determine whether magainins occur in 5 different species of the phylum Amphibia and to investigate the evolutionary development of the magainins, thereby evaluating the evolutionary relationship among the 5 species. It was expected that if the simplest animal tested, *N. maculosus* (the mudpuppy), had magainins, all of the species would have retained magainins in their evolutionary development. Furthermore, it was hypothesized that those animals that possess magainins would be more closely related than those that did not.

The DNA from blood cells was extracted and digested with restriction enzyme, EcoRI, and the resulting fragments were separated by gel electrophoresis. The DNA was denatured and transferred from the gel to a nitrocellulose filter using a Southern blot. The DNA which adhered to the filter was hybridized with the radioactive magainin probe. An autoradiogram was then prepared and analyzed.

The DNA hybridization analysis from *Xenopus laevis*, *Rana pipa*, *Bufo americanus*, *Necturus maculosus* and *Diemictylus viridescens* indicated that *B. americanus*, *R. pipa*, and *N. maculosus* possess a magainin-like gene. These experiments showed the greatest degree of homology in *N. maculosus*, which showed 3 sites for magainin probe binding. The lack of binding in the newt may indicate that *D. viridescens* is not as closely related to the other four species as expected. Work on the project is continuing to clarify and confirm the present results. Further experiments using different enzymes are planned.

*Second Award - ISEF/Zoology

CALF REARING - FROM BIRTH TO WEANING

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To sucessfully raise a calf, the immune system of the calf should be "built up" to fight off diseases. This is achieved by feeding the calf colostrum as soon as possible after birth. It was hypotesized that calves fed colostrum for the first three days of life and fermented colostrum from the fourth day to the twentieth day would gain more weight, have higher protein, hemoglobin, and glucose levels, and have lower white blood cell counts. The effectiveness of colostrum feeding to the calf's immune system was researched in Phase I.

The purpose of the research in Phase II was to determine the most effective and efficient method for rearing calves from birth to weaning. It was hypothesized that the calves in Group A, which were fed colostrum for the first three days and milk replacer containing 25% fat from the fourth day to the thirtieth day would have higher weight gains and be the most efficient method for raising calves.

Results from the experiment showed that the calves in Group A gained an average weight of 57 pounds at $2.13 per pound. The calves in Group B gained an average weight of 50 pounds at $2.00 per pound. The calves in Group C gained an average of 44 pounds at $1.66 per pound. The calves in Group A gained an average weight of 7 pounds more than Group B and 13 pounds more than Group C.

Thus, it was concluded that the Group A calves, fed fermented colostrum and 25% fat milk replacer, were healthier and achieved the highest weight gain.

* DETERMINATION OF OPTIMAL ENVIRONMENTS FOR FISH CELLS IN VITRO

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Tissues of cold-blooded organisms are said to be capable of propagation in relatively high temperatures, provided the temperatures do not exceed those the organism could withstand in its natural environment. However, in order to develop heartier cell lines, optimal environments must be experienced by the cells.

In my experiment, three fish cell lines (EPC, CHSE-214, CAR) were introduced to each of four environments (25°C without CO_2, 25°C with CO_2, 37°C without CO_2, 37°C with CO_2). CO_2 is an important factor in a cell's environment because of its rôle in media pH regulation. Viability counts were taken for five consecutive days after introduction to the environments.

All of the cell lines were more successfully propagated at 25°C. The EPC and CHSE-214 cells found 25°C with CO_2 to be favorable, probably because the media pH was maintained at desirable levels. Surprisingly, 25°C without CO_2 proved best for the CAR cells. Because these showed low viabilities with CO_2, it can be theorized that CO_2 has a somewhat toxic effect on CAR cells.

It is my conclusion that fish cells in vitro grow best at lower temperatures.

In the second phase of my research, thermotolerant cells were developed. In order to locate and isolate the factor which makes these cells able to withstand normally damaging temperatures, extracts were taken from them. Freshly subcultured cells were treated with the extracts and viability counts were taken after 1, 12, and 24 hours in a 37°C environment. Due to a number of factors, my data was determined to be inconclusive.

*Third Award - ISEF/Zoology

CONDITIONAL RESPONSES OF DUGESIA TIGRINA, CURA FOREMANIC AND PHAGOCATA OREGENOSIS

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I decided to proceed with last year's experimentation by using different species of planarians. I experimented to determine if planarians could be conditioned to respond through stimulation. After regeneration and feeding to other planarians, are the fed planarians more likely to respond quicker to the stimulation? My hypothesis was that planarians could be conditioned to maneuver through simple mazes. After subjected to conditioned training, the learned processes can be transferred through regeneration and cannibalism.

I trained three species of planarians to respond to light and shocks. After testing, I severed the planarians in transverse and longitudinal sections. After regeneration, responses to shock and light were determined. After the response, I fed untrained planarians species of trained planarians. After all fed planarians responded to the light only, a second experiment was started. Simple mazes were built out of sand paper and straws. I placed two planarians from each species in petri dishes with a simple maze. After responding to the right toward the straw of the maze, I pulled a "trick test" to see if they still responded to the right.

After all experimentation, I concluded that all species of planarians have the ability to be conditioned. Regeneration and cannibalism do affect the responses of other planarians.

THE BIOMECHANICS RELATED TO THE STRUCTURE AND LOCOMOTION OF WALKING-STICKS (PHASMATIDAE)

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The walking stick is a member of the family Phasmatidae, common in the forests of Puerto Rico.

Twenty six insects were measured, photographed and analized by a statistical study that gave an average model of the insect. The size of the abdomen (near 50% of the total length) and the length of the antennae are remarkable.

The structural study was centralized in the arrangement and dimmensions of the legs. These vary in size, been the smaller the ones in the mesothorax. A vectorial analysis was carried out. the proyections of each leg is described in the three orthogonal planes of a right coordinate system.

Several forces that act in this sturcture have been described. The drag force is aproximately 2.5 times the magnitude of the weight of the insect. The Gravity Center is located at 6.21mm over the ground, in an angle of 21.31° with the tarsus of the mesothoral legs. Physical tests demonstrated that these legs tolerate the higher compression due to weight. A Truss Analysis was carried out in the joints of the legs. It has been found that the femur-body junction consists of a three unknowns system, each of them been the rectangular component of the force in the union. The tibia-femur and tarsus-tibia junctions presented more complex systems composed by five unknowns, the reaction of three force and two copule components.

Studies of the movements of the femurs showed some geometrical figures in the different orthogonal planes. The proyection in space of this figures showed that the valid region of movement of femurs is given by the intersection of two Quadric Surfaces. The equations of each surface were described.

EARTHWORMS: HOW DOES FERTILIZER AFFECT THEM?

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The objective of this experiment was to determine the affects of various soil treatments on earthworms, and to determine if there was a negative reaction to the fertilizer, would adding compost to the fertilizers neutralize that affect.

Two fertilizers were used. One a balanced chemical fertilizer (13-13-13), and the other a fertilizer high in Nitrogen (27-3-3). Later compost was added to each treatment.

The treated soils were put in milk cartons with holes in the sides to allow the worms to travel to different cartons.

Seven redworms were placed in the top of each carton. After approximately 24 hours the soil was removed and the number of dead and alive worms in each carton was recorded. This proceedure was repeated three times.

It was found that the worms avoided both fertilizers, but chose the fertilizer high in Nitrogen over the balanced fertilizer.

It was also found that adding compost to the fertilizers neutralized both partially and doubled the number of worms in the treated soil.

It was concluded that earthworms do not like soil treated with fertilizers, either balanced or with High Nitrogen content. Adding compost to the soil drastically increased the number of earthworms.

Phalloceros caudimaculatus (Teleost fish) and Anacharis sp (Monocotyledonous plant) SALINITY TOLERANCE EXPERIMENT

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Striving to determine changes and the possible relationships that may occur in a "community" made up of a fish Phalloceros caudimaculatus and a plant Anacharis sp when submitted to salinity vatiations.

Thirty species of P. caudimaculatus (Teleost fish, Poeciliideous) and 60 sprigs of Anacharis sp (Monocotyledonous, Hydrocharidaceous) that had been recently pruned.

Animals and plants, together or separated, were submitted to two concentrate solutions: 5 g /l and 10 g/l of NaCl, having been weighed during a 24-hour interval (1, 6, 12 and 24 h after the start of the experiment).

Fishes and plants presented corporeal weight variations (losses and gains) during the 24 hours, having in common the fact that at the 1st hour they all lost weight.

It can be stated that both fish and Plant tolerate the tested salinities and that must have regulating mechanisms or constitution of their own.

The presence of Phalloceros seems to actuate on the Anacharis behaviour, although we cannot state the type of relationship present.

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* NOTES ON THE MATERIAL CHARACTERISTICS OF THREADS FROM TWO ORB-WEAVING SPIDERS: NEPHILA CLAVIPES AND GASTERACANTHA TETRACANTHA

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Nephila clavipes which lives in tropical and sub-tropical areas, belongs to the Orb-weaving Spiders group. It is specially recognized because of its golden web and its web resistance.

For the analysis of the web material we selected the most simple element in the construction of a spiderweb, the thread. A total of 50 Elasticity Tests were performed, with a special instrument we called "Elongation Meter". We changed all our data to the MKS of the International Metric System.

The Diameter of a hundred thread samples was determined. We assumed that the thread was cylindrical, uniform and isotropic. The Average Crossectional Area was analyzed using an statistical analysis that allowed us to determine the Average Area and the Standard Deviation of the sample.

For the Elongation Tests we used a set of weights, ranging from 0.01 to 1 gm. Continuous applications of weight were done until the thread broke. the elongations were determined using a Pythagorean Analysis. The Percentage of Elongation was determined. A force analysis was made to obtain the Stress and the Strain on the thread.

By the results of the Lateral and Axial Deformations, the Poisson's Ratio was determined. Using the earlier data (Stress and Strain), we made a Regressional Analysis using the Least Square Approximation for a 10th degree polynom. By means of this analysis we could determine parameters such as Toughness, Average Strain, Average Stress and others. As far as this study haas being developed, the threed shows a highly plastic behabior.

*Third Award - ISEF/Zoology

* WHAT ARE BENTHIC MACROINVERTEBRATES, AND HOW CAN THEY BE USED AS INDICATORS OF STREAM WATER QUALITY?

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Benthic macroinvertebrates and their larva are invertebrates that can be seen without a microscope and live in the beds of fresh water streams. I wanted to determine if these organisms could be used as a reliable indicator of stream water quality.

I conducted my study in the following manner. I researched methods for collecting benthic macroinvertebrates and proper water sampling techniques. I then designated 46 streams in my local area as sampling sites where I collected my organisms and water samples, being careful to use proper sampling techniques. The benthic macroinvertebrate population of each stream was indentified. I determined the Biotic Index (stream water quality) for each benthic macroinvertebrate population using the Beck's Index. My water samples were tested for organic pollution by the U.S. Forest Service Laboratory in Parsons, WV. Upon receiving the water test results I based my conclusion for each stream on a collective study of the organic substances found in the water.

In 43 of the 46 streams tested the benthic macroinvertebrate population and the water analysis results correlated perfectly. I then conclude that benthic macroinvertebrates can be used as a reliable and inexpensive method of determining stream water quality.

*Third Award - ISEF/Zoology

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* ECOLOGICAL STUDY OF THE SPINE BUG *UMBONIA CRASSICORNIS* AMYOT AND SERVILLE (1843):EMPHASIS ON ITS LIFE CYCLE AND POSSIBLE BIOLOGICAL CONTROLS

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Umbonia is considered a plague of ornamentals and fruit trees, for this reason it is considered of great economic resource. When it attacks a tree a masive infection occurs and it generally causes a great tissue deformation that end in death of the tree. Actually there are no investigations about their ecology and biological controls of this insect for this reason this study pretends to elucidate about them.

It has been shown that the insects attack some trees such like: *Albizzia lebbeck*, *Albizzia procera*, *Lusiloma bahamensis* and others. In this investigation it has been found that there are other families of trees infected by the spine bug, there are the following: *Delonix regia*, *Pithecellobium ungui-cati*, *Leucaena glaucca*, *Acacia farnesiana*, *Melicoccus begigatus (Sapindacea)*, *Sapindus saponarea*, *(Sapindacea)* and *Trichilia hirta* (Meliaceas).

Among the possible biological controls it was found: *Dysdercus andreae*, *Pheidole boriquensis*, *Apis mellifera*, *Chilicorus cacti*, *Maonobelus fasciatus*, *Dyaprepes abreviatus*, *Melanchroia cephise* (larvae), *Polistes menor* and others.

Tests realized directly in infected trees during three seasons of the year showed that the major population occurs in the hot months of the summer. Analysis of different environmental parameters were performed showing a significative difference in temperature and relative humidity. Collected samples of differents places shows the origen of a variety number of sub-species in this specie.

*Second Award - Entomological Society of America

ELECTROMAGNETIC FIELDS VS INVERTEBRATES, FIVE YEAR STUDY

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The purpose of this research was to determine the effects of Electromagnetic Fields on Musca Domestica.

20 Musca Domestica, house flies, were placed in an electromagnetic field relative in size to a Nuclear Magnetic Resonance Scanning Unit used in hospitals today. A control group of the same size was also used, but not exposed to the field. Two exposure times were used, 90 minutes and 180 minutes. Ten trials were observed for a period of 10 hours after the flies were removed from the field.

The number of flies in the control groups remained constant. Both experimental groups showed a significantly higher mortality rate than the control. These effects increased in relation to length of exposure.

Statistical analysis of data was performed using the Chi-Square Test and the Mann-Whitney U-Test. The tests indicated that there is less than 1% probability of the distribution occurring by chance.

The researcher concluded that electromagnetic fields have a detrimental effect on Musca Domestica.

This research supported four years of research on Artemia Salinia.

This data should enlighten the reader as to possible biological effects from the electromagnetic fields that we are subject to each day. The research should be of interest to the Military Services relative to studies, past and present, on the biological effects of Electromagnetic Pulse.

*First Award - U.S. Air Force
Third Award - ISEF/Zoology

EFFECTS OF INGESTION OF CAFFEINE THROUGH INTUBATION BY MALE MICE ON THE BIRTH DEFORMITY RATE, AS WELL AS THE STATURE AND QUANTITY OF THEIR OFFSPRING

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In the previous two years of experimentation, it was determined that caffeine did indeed cause an increase in the birth deformity rate of offspring born to female mice who had ingested caffeine during pregnancy. A theory as to the explanation of this was that the caffeine somehow interrupted the pregnancy cycle of the female mouse, therefore causing an incomplete phase in the developement of the unborn pups. It was not thought that the caffeine interfered genetically with the developement of the pups. This year's experiment was aimed at proving, or at least strengthening, this theory. By administering the caffeine to only the male mice, the possibility of interruption of the pregnancy cycle was removed since the male mice play no role in the pregnancy cycle itself. With the experimentation concluded and the data collected, it was obvious that the intubation of caffeine to male mice caused no significant change in the birth deformity rate of their offspring. This strengthened, but did not conclusively prove the preconceived theory. Although no significant birth deformities were observed, there were substantially smaller litter, with a smaller average birth weight in the experimental groups as compared to that of the control groups. In conclusion, I believe that my interruption theory has been supported (though additional experimentation would be necessary for conclusive proof of it) and that the ingestion of caffeine by adult mice does not appear to cause genetic mutations among the offspring of these mice.

# X-RAY INDUCED TRANSLOCATIONS IN THE 2ND AND 3RD CHROMOSONES OF DROSOPHILA

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X-rays are known to induce chromosomal rearrangements. One type of rearrangement is translocation. A translocation results from the actual interchange of a block of genes between two nonhomologous chromosomes. Using a strain of *Drosophila melanogaster* with a known genetic marker, one can select for translocation involving specific chromosomes.

For this study, X-radiation was used to induce chromosomal translocations between the second and third chromosomes of *Drosophila melanogaster*. Oregon R. (OR) wild type males were irradiated at a dose rate of 509.4 roetgen (r) per minute for a total of 4,000 r, which is a 50% lethal dose for *Drosophilla spermatozoa*.

Irradiated males were crossed with vestigial (vg) ebony (e) virgin females. Vestigial ebony is a gene marker for the number two autosome in *Drosophila*, and ebony is a gene marker for the number three chromosome. The males of the F_1 generation were crossed with vestigial ebony virgin females.

In the F_2 generation, flies carrying the second and third translocations were identified by the failure of vestigial and ebony marker genes to assort independently. Of the 255 F_2 males studied, 9.4% identified with true translocation on the second and third chromosomes, 2.1% with possible translocation and 88.5% with no translocation.

Two of the true translocations were selected for cytological study. They both confirmed that X-rays induced chromosomal translocation between the second and the third chromosomes.

#Second Award - U.S. Air Force
Fourth Award - ISEF/Zoology

# AN ECOLOGICAL, MORPHOLOGICAL AND BEHAVIORAL STUDY OF THE FRESH WATER SHRIMP *XIPHOCARIS ELONGATA*

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In 1889, Pocock studied the Genus *Xiphocaris* in Jamaica, Cuba and Dominica. He found that in this species only the *X. elongata* species exists. Continuing with t he research he found that this unique species is divided in a varieties, *Xiphocaris elongata*: a) typica, b) variabilis, c) breviostris, d) gladiator.

In Puerto Rico this crustacean of the family Atydae is known as "chirpe", also study has been conducted and the classification of the varieties has been performed in our island.

This study is based in the analysis of the ecology, morphology and behavior of this shrimp. Tests as stomach content, zonation, parasites, protein content and calcination are among the ones to which the species are going to be submitted.

Up to now the light and dark preference test has revealed that 59% of variety A preferred darkness, 39% in variety B, 54% in variety C, and in variety D 54% preferred the dark side. Variety A preferred light in 36% at the times, variety B in 50%, variety C in 41% and variety D with 38%. In summary variety A prefers more the darkness that the rest of the varieties and variety B prefers the light more.

The color preference test revelaed that variety A preferred black as B and C, excepting color D which prefer yellow.

#Fourth Award - ISEF/Zoology

ZETETICONTUS UTILIS - A BIOLOGICAL CONTROL

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The souring beetle ("Pineapple Bug") has become a nuisance and pest in Hawaii. Although the beetles are not life or crop threatening, they are causing many public complaints. Large swarms of them infest residential and resort areas.

In light of the concerns over the use of pesticides to control unwanted insects, I chose to investigate the establishment of Zeteticontus utilis, a parasite of the souring beetle that was recently introduced as a biological control of the souring beetle. Field research was done to show whether or not the tiny wasp has migrated from the fields where they were released by the Department of Agriculture, State of Hawaii.

To determine whether or not the parasite has moved to other fields a series of traps was set in various fields. Within these traps were pieces of cut pineapple rind containing souring beetle larvae. The larvae are the bait for the trap. The parasites enter the trap and lay their eggs within the souring beetle larvae. After one day, the traps are retrieved and the bait is kept in a covered jar. In approximately 20 days, the parasites will hatch, thus showing whether or not the parasite is present in that field.

From the results of these trappings I have determined that the parasites have established themselves in fields outside the area they were released. Although I did not obtain proof that the population of souring beetles was reduced by the presence of the parasite, I plan to continue my research in this area.

A STUDY OF PAPILIO PROTENOR CRAMA (LEPIDOPTERA, PAPILIOAIDAE): THE TAXONOMICAL RANKING AND DIFFERENTIATION OF THE TWO SUBSPECIES.

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Papilio Protenor Cramer is a species of butterfly distributed in Asia; there are vast differences between its two subspecies on the morphology. This study researches the morphology, ecology, and differentiation in species of the two subspecies by raising accumulative generations.

The consequences are as follow:

1. Morphology: the Japanese subspecies(subsp. demetrius) is always bigger than the subspecies(subsp. amaura) in Taiwan in the same surroundings, and the Swallow-tailed form is about 10mm longer than the non-Swallow-tailed form in the fourth Neins(hind-Wings). In addition, during the pupa/stage of larval/stages its head has conical salients; the subspecies in Taiwan is bent, but not the Japanese subspecies.
2. Ecology: the two subspecies take in food/plants according to different priorities. The most suitable temperature for the subspecies in Taiwan is 25-30°c.
3. Taxonomy: the two subspecies comprise different hereditary-genutype, and on differentiation the two Subspecies are always far more distinguished than their geographical populations.
4. Conclusion: because of reproductive partition, the two subspecies will be able to gradually and naturally evolve into two independent species.

* A POPULATION STUDY OF TARDIGRADES IN HOWARD COUNTY AND HOW AGRICULTURAL AND INDUSTRIAL POLLUTION AFFECTS THE BIOCHEMICAL ASPECTS OF THEIR CRYPTOBIOSIS

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The purpose was to prove the value of tardigrades as a pollution indicator. HYPOTHESIS: If the time span between the cryptobiotic and the animated states varies from the normal (distilled water, 14 minutes), then the pollution adversely affects the tardigrades, thus demonstrating their pollution indicator abilities. The experiments were divided into four phases. In phase I, a control of distilled water was tested on a random group of five tardigrades by placing three drops of the control (with dissolved oxygen content of 5±1%) onto the slide of the tardigrades. The industrial pollutions that represented acids (HCl), bases ($NH_3(aq)$), banned chemicals (.05M Na_3PO_4) and harmful chemicals (.033M $Pb(NO_3)_2$) were tested similarly to the control. In phase II where .05M trehalose was similarly placed on a slide, tardigrades began to swell, nearly burst, yet never animated. Trehalose and glycerol are the biochemicals that control cryptobiosis. A .0125M trehalose solution accelerated animation at the highly significant level ($\chi^2=8.04$, 1df). In phase III, five common agricultural pesticides were placed in solution to stimulate the runoff from fields that were plowed using "no till," "minimal till" or "full till" techniques. "No till" was better ecologically with all pesticides, whereas "full till" eliminated the tardigrades. Phase IV correlated theoretical and factual data by sampling the moss from every geographical mile of Howard County's Wildcat Creek. In these locations, a direct correlation between phase III and IV was found because no tardigrades existed in "full till" watersheds. However, in "no till" watersheds, Tardigrades flourished.

***Third Award - ISEF/Zoology**

WHAT IS THE BEST METHOD FOR GROWING EARTHWORMS?

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The purpose of this project was to determine whether earthworms would grow better if placed in soil with pieces of cardboard cut up in it. The hypothesis was that the containers with the cardboard would cause the worms to grow faster than the others.

Two worms were placed in each container and there were six types of mixtures: sawdust, regular soil, cardboard, newspaper, rabbit manure, and mulch with three containers under each category for a total of eighteen containers and thirty-six worms.

They were measured every Sunday in centimeters and their growth was charted. They were watered frequently. On each pan a piece of wet burlap was placed to keep in moisture. One fourth of each mixture was mixed with the regular soil. A thin layer of sawdust was added to the bottom to hold in water. Small holes were punched to allow for drainage.

The materials used were loaf pans, rubber gloves, water, burlap, cornmeal, and a ruler plus the mixtures and worms.

The results were that the pans with the mulch grew much faster than the others. One can conclude that if one wants to grow worms, one would use mulch in the soil. The hypothesis was incorrect.

If one were to do this project again, one might make it work better if he/she could keep measurements for a longer time and have a better system for measuring the worms. Using a ruler was extremely hard. Also, a greater amount of worms and variety of mixtures might have made it better.

*PIGMENTATION RESEARCH USING THE MEXICAN AXOLOTL

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The purpose of my project is to investigate the function of pigmentation in vertebrates by chemical alteration using the Mexican axolotl as test specimens as a means of correcting certain pigment defects possibly relating to human pigment defects.

Six Mexican axolotls were divided into three groups, one control and two experimental. The axolotls were raised in fifty percent Holtfreter's solution at twenty degrees Celsius. This was changed every other day. The control group was fed plain beef liver and all three groups were fed live brine shrimp daily. The first experimental group was fed allopurinol coated beef liver and the second group was fed guanosine coated beef liver and plain beef liver on alternate days.

Allopurinol enhanced the melanophore pigment cells making the axolotls appear darker and suppressed the xanthophore and iridiophore pigment cells. The guanosine enhanced the iridiophore and xanthphore pigment cells making the axolotls appear to be a bright yellow color and suppressed the melanophore pigment cells. Administering the chemicals did not have a significant effect on their weight, length, or general health.

This research supports the hypothesis that chemical alteration of pigmentation is feasible, making this significant relative to disease and abnormalities involving pigmentation.

***Fourth Award - ISEF/Zoology**

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*MYSTERIOUS RIGHT-ANGLED FLIGHT OF SWALLOWTAIL

(_Papilio_ _protenor_ Cramer: Lepidoptera)

Nara, Shigeyuki, Matsuyama H.S., Higashimatsuyama, Saitama 355
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On a summer day in 1986, I happened to notice the strange flight of a swallowtail (_Papilio_ _protenor_). It was flying alongside a building wall and when reaching a rectangular corner, it abtuptly changed its flying course by 90 degrees and flew away along the other side of the wall. I named this strange flight "right-angled flight". I then started research to solve why the butterfly flew in such a manner by chasing and recording their flight paths.

I found that every "right-angled flight" of the swallowtails occurred at the very rectangular corner of the periphery of woods or building walls.

Configurations of the ground, woods, and buildings were examined, and luminous intensity was measured by a photometer.

Since "right-angled flight"happened under various luminous intensities, I assumed that configurations influenced the fliying paths.

Next, I investigated the influence of luminous intensity on the fluttering of a swallowtail. I flashed a tied butterfly with a storoboscope, varing the distance gradually. It was found that the swallowtail fluttered intensively when it was flashed from a distance of not more than 30 cm.

In conclusion, I consided that the _Papilio_ _protenor_'s "right-angled flight" is decided by configurations, while height and speed of the flight are greatly influenced by luminous intensity.

***Fourth Award - ISEF/Zoology**

OCCURENCE AND TRANSMISSION OF STEROID INDUCED GENETIC MUTATIONS

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The purpose of this project is to observe the effects of Winstrol; (an anabolic steroid from testosterone) on mutation rates in *Drosophila melanogaster*. Winstrol has been effective in increasing hemoglobin levels in some patients with aplastic anemia. Reactions to oral anabolic steroids include nausea, diarrhea, and insomnia. Most importantly, it does not increase athletic ability. DMSO (dimethyl sulfoxide); a liquid which is miscible with water, was used as the carrier for the steroid. Its wide spectrum of pharmacological action includes muscle relaxant and membrane penetrant.

By adding .1 mL of a 6.05×10^{-4} steroid/DMSO solution to 9.9 mL of water, the equivalent human dosage of 2 mg was achieved. This was added to the Drosophila medium. With this procedure Winstrol may be absorbed two ways; through the body or ingested. The effects of the dosage in subsequent generations were observed and recorded.

First generation mutations were minor in nature, involving simple wing changes and eye color mutations. The mutation rate was calculated at about 6%. A significant increase was noted in the second generation however, with the mutation rate averaging 86% over a wide variety of mutation types. A third generation was unable to produce any viable larvae. Research is continuing in an attempt to substantiate these findings.

* EFFECTS OF ULTRAVIOLET RADIATION ON *LUMBRICUS TERRESTRIS*, ESPECIALLY ON ITS REGENERATIVE ABILITIES, PHASE II

Chavez, Eric M., Dale H.S., Dale, OK 74838
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This two year study was done to determine what effects ultraviolet radiation has on earthworms. Exceptional consideration was given to experiments concerning how the ultraviolet radiation affected the earthworms' regenerative abilities. Ten earthworms were exposed to the ultraviolet radiation produced by a sixty hertz blacklight. Another ten earthworms were used as controls. After one hundred fifty-six hours of exposure time, regeneration experiments were begun. Ten exposed earthworms and four control earthworms were tested for regenerative abilities by first excising ten segments from each earthworm's posterior section and then measuring the time it took for the segments to be regenerated. Several abnormalities of the earthworms' gross anatomy were noticed that sparked a histological study. Microscopic slides were made of two exposed earthworms and one control earthworm. The slides were examined, and a medical pathologist confirmed my conclusions of goblet cell depletion (observed by an inability to produce mucus), and muscle degradation (observed by constricted segments). Seven of the ten exposed earthworms died. Zero of ten control earthworms died. Sixty percent of the exposed earthworms regenerated at least three segments. One hundred percent of the control earthworms regenerated at least eight segments. In summation, the effects of ultraviolet radiation on earthworms are: swollen hard bumps, indented spots, and constricted segments all on the earthworms' skin; water loss, goblet cell depletion, inability to produce mucus, muscle degradation, slowed regenerative ability, and death. Current study is being done to determine if a neoplastic process found in the earthworm's outer epidermis actually is a benign or malignant form of cancer.

*Fourth Award - ISEF/Zoology

A BEHAVIORAL STUDY OF THE COMMENSAL FISH *CARAPUS BERMUDENSIS* JONES WITH NEW HOST RECORDS FOR THE WATERS OF SOUTHWESTERN PUERTO RICO: SPECIAL ATTENTION TO THE MECHANISM OF HOST LOCATION

Vega, Michael, Lola Rodríguez de Tio H.S., San Germán, P.R. 00753
Bo. Guamá Carr. 362 Km. 5.5, San Germán, P.R. 00753

This study attempts to determine the behavior of the fish *Carapus bermudensis* in the waters of Southwestern Puerto Rico. An attempt is being made to detect new host records for the fish in Puerto Rico as well as survey all the known host records for the fish at the present time. The mechanism of host location by the fish is being studied.

A big total of 8,487 host have been collected with a total of 161 fishes present in them. The host with the largest number of fishes was *H. mexicana* with 2.11% of infection. The fish can see its main host 86% of the time in an average time of 1:42 minutes. The fish response against different parts of the anatomy of its main host indicate that the substance that attracts the fish to its host is located in the peritoneum with a response of 89% in an average time of 1:23 minutes. The fish responds to host odors 86% of the time an average time of 1:42 minutes. The fish responds to visual test in a similar form against *H. mexicana* and *I. badionatus* 3% in a time of 1:22 minutes and *H. mexicana* in 11% in a time of 1:50 minutes. It is obvious that the substance that attracts the fish to its host is located in the peritoneum. Attempts are being made to detect the nature of this substance with chromatography.

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* DOES ANGULAR POSITIONING AFFECT A BIKERS EFFICIENCY ? 2 YEAR STUDY

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PHASE 1: The purpose of my research was to determine if I could develope and construct a more efficient bicycle. I purchased four different bicycles for frame and component parts. These four bicycles were then cannabilised to provide parts for my recombinant bicycle. The frame parts were cut, bent and then welded together to form my new frame.

Once assembled, I mounted two types of bicycles, standard ten speed and recombinant ten speed, on a conditioner for metabolic tests in a lab at Mankato State University. This researcher has found his metabolic rate to be markedly reduced with the recombinant bicycle as compared to a standard mass produced ten speed bicycle making my bicycle more efficient.

PHASE II: The purpose of my research was to determine if angular positioning does affect a bikers metabolic rate.

The standard forward position, at 45 degrees in addition to the recombinant 110,115,120,125,130,135,140 degrees were tested. The test seat was made for variable angular positions but remained otherwise the same as the seat on my recombinant.

Metabolic tests were completed with the aid of a Collins Respirometer. An Integrator Pedal Mode Ergometer was adapted and used as a replica of my recombinant in the laboratory.

All tests were done in three minute periods and completed three times. All tests were performed at the physiology lab at Mankato State University. Ergometer work load remained the same for all tests. 2.5 Kgs./m.

This researcher found that angular positioning of 120 degrees showed a marked increase in efficiency when compared to the other standard positions and angles.

*Third Award - ISEF/Zoology

THE LIMULUS STIMULUS

Christopher James Lauricella
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Limulus Polyphemus, the horseshoe crab, is commonly referred to as a living fossil. By studying many physiological and behavioral aspects of this animal, we can gain insight into prehistoric life. I plan to present data which may show how Limulus orients itself toward the beach. The information gathered may prove to be beneficial to biologists by giving them a greater understanding of how past animals lived.

SAFE ROACH CONTROL

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The purpose of this project was to determine whether roaches were attracted to carpet tape and whether the tape could be used as a safe, effective control.

Strips of different brands of carpet tape were placed on different colored backgrounds and spread throughout a house where cockroaches were present. Each morning the tape was checked.

Over a three-year period, Ace Carpet Tape proved to be an effective agent for attracting and holding roaches. Color did not appear to be a significant factor in attracting roaches. The tape proved to be an effective control of roaches in the house.

BEHAVIORAL PATTERNS OF ARCTIC FOXES AT THE MINNESOTA ZOO

Stelzig, Sharon M.
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A group of seven arctic foxes (Alopex lagopus) was observed at the Minnesota Zoo. The objectives of the study were to determine how the foxes used the areas in their exhibit, how visible they were to the public, and how their activity patterns varied throughout the day. This study also attempted to determine the nature of social interactions within the group in order to detect any excessive aggressive behavior among the animals.

The method used was instantaneous scan with one minute intervals.

It was found that although the foxes spent most of their time inactive, they were very visible (five to six foxes generally visible) and exhibited only a small amount of aggression (four percent of total time observed).

REPRODUCTIVE BEHAVIOR ADAPTATION IN POECILIA FORMOSA

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Problem and Hypothesis:

The Amazon molly is a species of fish that occurs only as females. They mate with males of related species to produce young that are 100% female. Because all of the offspring are capable of bearing more young (as compared to 50% with any other species), the Amazon molly must adapt its mating behavior to prevent overpopulation . The Amazon molly should increase signs of mating behavior as males are more abundant and decrease agression when males are scarce.

Procedure:

Two tanks were established with three females in each. One tank was the control group with three common mollies. The second one was the trial group with three Amazon mollies. The number of males in each tank was adjusted to create different ratios of males to females. The tanks were observed for periods of ten minutes each, four times per phase. Data was collected and analyzed.

Conclusion:

The results of the experiments were the exact opposite of what was predicted. The control group showed more displays of mating behavior as the number of males increased. The Amazons, however, showed a marked decrease in mating behavior as the number of males increased. Therefore, the aggression of the Amazon mollies is in inverse proportion to the number of males present.

CHEMORECEPTORS IN THE AMERICAN COCKROACH

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Methodology for Experiment #1 The basis of this experiment is to demonstrate the antennae as the chemoreceptors of the cockroach. In the presence of Trans-2-Nonenal, the normal aggregation behavior of cockroaches is affected. Insect samples are antennectomized or tarsecetomized as a control. Experiment #2: EAG recordings were done to detect specific responses in the cockroach to the chemical.
Observations: The results of the Experiment #1 demonstrated 15% of the antennectomized roaches to be attracted (by the attractancy formula) by the chemical. 65% of the tarsectomized insects were repelled. Data from Experiment #2 is pending.
Conclusion: According to the results of the first batch of experiments, the receptor of chemical repulsion on the insects is the antennae. With antennectomized cockroaches the effect on behavior is negligible. The hypothesis is therefore verified. With tarsectomized cockroach samples repulsion was noted. The results of the EAG research are still pending.

QUANTITATIVE DETERMINATION OF SPECIES IN MACROCALLISTA

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Macrocallista is a genus of bivalve mollusks dating from the Miocene Epoch in southeastern North America. This project compares fossil and recent populations of *Macrocallista* to determine which species are statistically valid with respect to the measured parameters and to evaluate the utility of various quantitative techniques for this determination. The shells are smooth in outline, without ribs or other surface ornamentation, so that the fossil species appear to grade into each other. However, ultraviolet light reveals color patterns on exceptionally well-preserved specimens.

Various dimensions are used to compare over two hundred specimens. Height and width were measured with calipers and the resultant ratios were calculated. Then an IBM computer with an ART 3 program was used to determine average diameter and to array these data for shape analysis using Fourier harmonics. SAS program R-mode cluster analysis and discriminant analysis compared data sets for height/width ratios, height/average diameter ratios, and Fourier harmonics. Of the methods tested, Fourier harmonics proves to be the most effective tool for determining species limits in *Macrocallista*. From the twenty-three nominant species analyzed, five species can be justified by this study. An additional two are possibly valid species, but they are represented by insufficient material for specific determination.

PIG OUT!

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The purpose of this project is to prove that "junk food" has adverse effects on health and performance of mice.

The experiment consisted of three phases. In the first phase the control group contained two mice. They were fed a nutritionally balanced diet for thirty days. The experimental group also consisted of two mice. However, these were fed a diet of "junk food" for thirty days. During the second phase the mice were run through a maze to test the effect of the diet on their performance. In the final phase the physical health including fur condition, appearance,and weight were evaluated. The data of the experiment proved that the performance and health of mice were affected by their diet. Between the control and experimental groups there was a significant time difference in the completion of the maze test. The experimental group was slower than the control and showed less cooperation in the test. It was observed that the control group looked healthier and acted more cooperative than the experimental group.

The result of the experiment showed that the health and performance of the "junk food" mice were inferior to those that had been fed a balanced diet.

# TWO YEAR STUDY OF THE BIOLOGICAL COMPASS OF A WATERSNAIL

April Johnson
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Pigeons, honeybees, slugs, and magnetic bacteria possess the ability to orient themselves on the earth's surface by use of the earth's magnetic field. In addition, these organisms have been found to possess iron ions in their bodies. The purpose of this experiment was to study the effects of a magnetic field on watersnails' sense of orientation and to determine if watersnails possess iron ions in their bodies. The watersnails were subjected to a rotating magnetic field, the earth's magnetic field, and two other stronger fields (one oriented north-south and one oriented east-west). Then the water snails were deshelled and treated with ferricyanide to test for the presence of Fe(II) ions, and treated with ferrocyanide to test for the presence of Fe(III) ions. The conclusions are that watersnails have no sense of orientation in a rotating magnetic field but have a preferential orientation in the three fixed magnetic fields, and that Fe(III) ions are present in the bodies of watersnails. Furthur studies on the tissue of watersnails are in progress.

*Second Award - Sigma Xi, The Scientific Research Society

ANTHONOMUS GRANDIS: THE EFFECTS OF SOUND FREQUENCIES ON THEIR BEHAVIOR
Darrell Whitley, Harlingen High School, 1201 E. Marshall, Harlingen, Tx.,
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Man Many of the valley farmers spend more than fifty percent of their profit on pesticides. In an effort to compensate for such high costs of pest control, I have formulated the hypothesis of using sound frequencies instead of chemicals for an efficient bug trap.

The first stage of this project was to produce selected sound frequencies from an electronic circuit board that I have built. There are many pictures in the albums that illustrate the boll weevils repulsion from the sound.

The second stage of this project was to acutally photograph changes in the boll weevils tympannae. These photographs were taken with Nikon FG-20 35 mm camera with a microscope adapter connected to a 10X lens. The movement of the insects hind leg is directly related to the movement of itstympannae. Thus the insects will be observed under a microscope to obtain data. These results will be recorded on film and graphs presented with the project.

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